THE
LARYNGOSCOPE.

VOL. LXX JUNE, 1960 No. 6

DYSRHYTHMIA IN THE POST-CALORIC NYSTAGMUS. ITS CLINICAL SIGNIFICANCE.*

J. S. RIESCO-MACCLURE, M.D.,
(By Invitation),
and
MALCOLM H. STROUD, M.D.,
(By Invitation),
St. Louis, Mo.

The functional examination of the vestibular system is based primarily on the observation and study of one sign, the nystagmus. The study of nystagmus, however, is not easy because of its great variety of form and presentation.

First, there is spontaneous nystagmus which may be due to an inner ear disturbance; to a lesion in the central vestibular system; it may be of cerebellar origin, or it may even be present in supratentorial tumors.

Second, there is positional nystagmus which according to Nylén's[1] classification might be divided into three different types. Aschan's[2] modification of Nylén's classification is in perfect agreement with our clinical experience; therefore, we have adopted it. Type I is a direction-changing nystagmus, non-paroxysmal, with no latency period, persistent (which means nystagmus of unlimited duration in a given position), and very seldom accompanied by postural vertigo. It is found chiefly in posterior fossa lesions.[3]

*Read at the Sixty-Third Annual Meeting of the American Laryngological, Rhinological and Otological Society, Inc., Miami Beach, Fla., March 15, 1960.

Editor's Note: This manuscript received in The Laryngoscope Office and accepted for publication April 7, 1960.

Type II is a direction-fixed nystagmus. Whatever the position of the head, the nystagmus always beats in the same direction.

Type III is again a direction-changing nystagmus, but paroxysmal in character, with a short latency period preceding the onset of the nystagmus. It is transitory, since it lasts for a short period of ten to 30 seconds, and is also transitional, since it may change its direction with any given posture, and is usually accompanied by severe postural vertigo. This type has been called "paroxysmal positional nystagmus of the benign type"[4] because as a rule it is a sign of a benign disturbance; nevertheless, we[3] have been able to verify it in two cases of astrocytoma in the cerebellar vermis, and recently Fernández, et al.,[5] have demonstrated it in cats, after the flocculo-nodular lobe in the cerebellar vermis was surgically damaged.

The clinical significance of Type II depends on its similarity with the other two types. If it is direction-fixed, non-paroxysmal, persistent and without postural vertigo it should be grouped with Type I. In 27 patients with encephalic lesions[6] we found Type I in 13 and Type II in 14. On the contrary, if it is paroxysmal, transitory and accompanied by severe postural vertigo, we group it with Type III which as we said, is usually a benign condition.

Fernández, et al.,[7] have found that ablation of the nodulus in the cat was followed by a Type II vertical nystagmus toward the lower eyelids, either persistent or transitory. In some animals, however, a paroxysmal nystagmus was superimposed upon the persistent one. Both were in the same direction, but the paroxysmal feature appeared after a short latency period and lasted for a few seconds. We believe this unusual disorder should be looked for in patients with suspected lesions in the cerebellar vermis.

Finally, there are *abnormalities in the nystagmus induced by the caloric tests.* We shall mention them briefly: *1.* Dissociation between the cold and hot responses.[8] This means the nystagmus may be induced only by irrigation with water at 44° and not with water at 30° or at 18° (a condition which

may be seen in streptomycin intoxication). *2.* Vestibular hyperexcitability. This means a large and long duration nystagmus, above the normal values. We believe it is due to an increased excitatory state of the central vestibular system rather than to an end-organ hyperexcitability.[6] *3.* Cochlea-vestibular dissociation.[6] This means normal hearing and complete vestibular paralysis (we have found it in tumors destroying the vestibular nuclei in the floor of the fourth ventricle). *4.* Nystagmo-vertiginous dissociation (large post-caloric nystagmus without sensation of vertigo). We believe this is due to a cortical inhibition of the sensation; it also might be present in lesions in various sites of the brain. *5.* Directional preponderance of the nystagmus.[9] This means the elicited nystagmus is larger in amplitude and longer in duration in a certain direction, regardless of the ear stimulated (a condition sometimes seen in brain stem lesions as well as in cases of Ménière's disease).[6] *6.* Perverted nystagmus. This means the nystagmus induced by caloric stimulation in the usual position is vertical instead of horizontal. We have verified it in partially destructive lesions of the vestibular nuclei.[8] *7.* The absence of the quick component. This is a rare otoneurological symptom. According to Nylén[10] and Aubry[11] it is found when the medial longitudinal fasciculus has been involved by lesions in the pons or brain stem. Experimental work, however, has shown that lesions in the reticular formation without sectioning the medial longitudinal fasciculus produce a monophasic nystagmus consisting of a steady slow component (Lorente de No[12]). *8.* Inhibition of the nystagmus either with the eyes open due to fixation of the visual axis, or occasionally only, with the eyes closed due to a higher (perhaps cortical) inhibiting influence. There is no question that in the majority of the cases the nystagmogram shows a larger nystagmus with the eyes closed,[2] due to the fact that fixation of the gaze inhibits the nystagmus when the eyes are open; but not too infrequently there are exceptions in which the nystagmogram shows no nystagmus when the eyes are closed and a clear nystagmus as soon as the eyes are opened (see Fig. 1). We believe that some individuals are capable of inhibiting the nystagmus without voluntary effort by some unknown mechanism. Because this

inhibition may be overcome by distracting the patient's attention we think that it could be of cortical origin. It does not depend upon the presence of a sensation of vertigo (see Fig. 2).

There is another abnormality in the post-caloric nystagmus which one of us (J. S. R-McC) has observed during the last

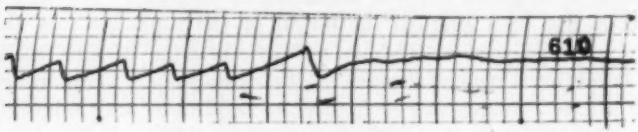


Fig. 1. Post-caloric nystagmus present only with the eyes open. It disappears with the eyes closed due to inhibition.

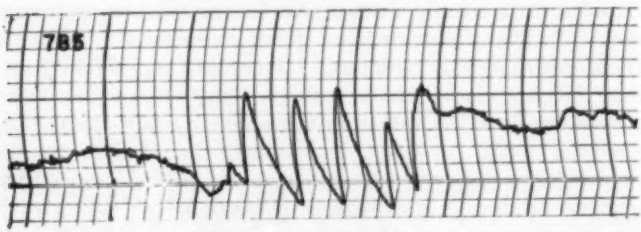


Fig. 2. Post-caloric nystagmus with the eyes closed. It appears only when the patient is distracted by conversation such as "Have you ever been in jail?"

three years and termed it "irregularity." This is because the eye oscillations were not regular in their amplitude and frequency, and sometimes the nystagmus appeared in periods of a few seconds with pauses of a few seconds during which no nystagmus could be seen. Aschan[2] refers to it as a "dysrhythmia in nystagmus induced by calorization." He states, "We have quite often seen such dysrhythmia, in cases of suspected cerebral lesions, but we have encountered it only extremely rarely in connection with peripheral lesions . . . ."

The purpose of this communication is to study the clinical significance of this otoneurological sign (dysrhythmia of the post-caloric nystagmus) and to emphasize its value in the diagnosis and localization of central vestibular lesions.

In order to present this otoneurological sign and its clinical significance we have adopted the following procedure for this publication: *1.* a description of that part of the central vestibular system in which a lesion might produce the sign; *2.* a report of our early cases in which the dysrhythmic nystagmus was verified by direct observation; *3.* a report of two cases examined with electronystagmography; and *4.* a discussion of the subject.

THE CEREBELLO-VESTIBULAR INTERRELATIONSHIP.

The cell bodies of the first vestibular neuron are in the vestibular ganglion or Scarpa's ganglion which appears as an enlargement of the vestibular nerve in the internal auditory meatus. Their dendrites are the nerve fibers which originate at the specialized epithelium of the cristae and maculae and form the three ampullary nerves, the utricular and the saccular nerves. Their axons form the vestibular nerve. When this enters the medulla oblongata (bulb) it divides into two fascicles: one is the "vestibulo-bulbar" root which conveys impulses to the vestibular nuclei of the brain stem; the other is the "vestibulo-cerebellar" root which conveys impulses directly from the vestibular receptors to the flocculo-nodular lobe of the cerebellum, to the fastigial nuclei and in a lesser degree to some parts of the cerebellar vermis, such as the lingula in the anterior lobe and the uvula in the posterior lobe (see Fig. 3).

The flocculo-nodular lobe is the vestibular lobe of the cerebellum, and its afferent and efferent connections are almost entirely vestibular. The afferent fibers are *predominantly* of vestibular origin. Some of them are primary neurons which come directly from the vestibular nerve (see Fig. 3) and others are secondary neurons from the vestibular nuclei in the floor of the fourth ventricle (see Fig. 4). These fibers which are estimated to be five times as numerous as

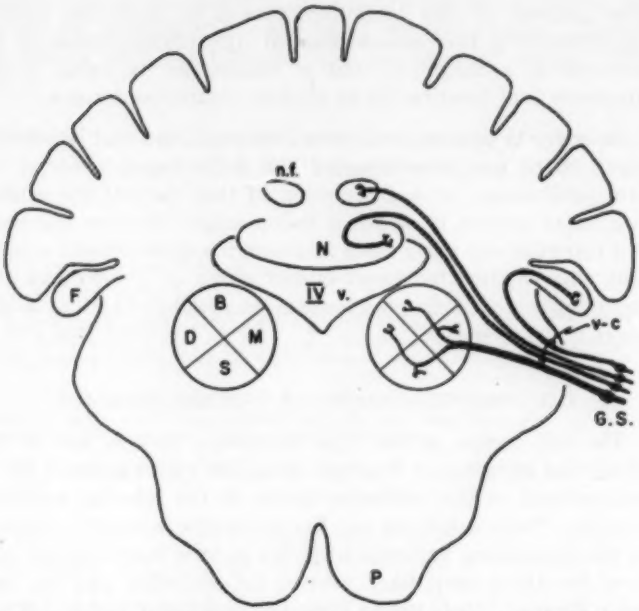


Fig. 3. Afferent primary vestibular neurons. This oversimplified diagram was composed after the description of Dow[13,15] and Jansen and Brodal.[12] In this and following figures the structures are identified by the symbols: F, flocculus; N, nodulus; IV v., fourth ventricle; n.f., nucleus fastigii; B, nucleus of Bechterew; D, nucleus of Deiters; M, medial nucleus; S, descending nucleus; v-c, vestibulo-cerebellar root; G.S., Scarpa's ganglion; P, pyramid. For the description of the pathways see text. In order to simplify this figure, the lingula and uvula were omitted.

the direct fibers[13] originate mainly in the medial and descending vestibular nuclei. They run dorsally into the cerebellum on the medial aspect of the restiform body (juxtarestiform body) between the latter and the fourth ventricle. Some of these bend laterally over the restiform body to reach the flocculus of the same side; others turn medially on the cerebellar wall of the ventricle (roof), ending in the nodulus, uvula, and fastigial nuclei of both sides, and some pass to the flocculus of the opposite side.[13,14,15]

The efferent fibers of the nodulus may be divided into short and long Purkinje axons. The former end in the nucleus fastigius and the latter in the vestibular nuclei, reticular

formation and medial longitudinal fasciculus. All these connections are ipsilateral (see Fig. 5). The efferent fibers of the flocculus also are ipsilateral long Purkinje axons. According to Jansen and Brodal[15] "the efferent fibers from the flocculus pass the floccular peduncle and then follow two routes. One group of fibers arches above the fibers of the

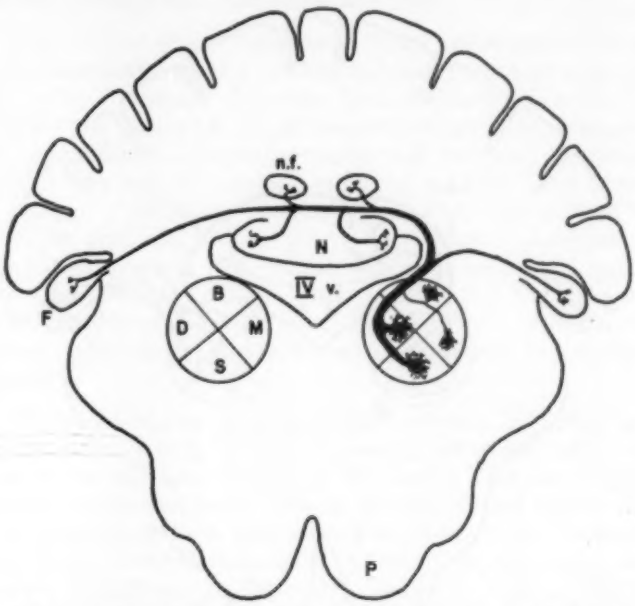


Fig. 4. Afferent secondary vestibular neurons to the cerebellum. See text for the description.

restiform body to terminate in the dorsolateral part of the vestibular nucleus of Deiters. The remainder of the fibers forms the 'angular bundle' of Lowy which within the medial part of the juxtarestiform body turns sharply in a rostral direction to terminate in the vestibular nucleus of Bechterew."

The flocculonodular lobe and its afferent and efferent connections are phylogenetically the most ancient and the name of archicerebellum has, therefore, been given to this lobe.

Apparently the cerebellar stamp has to be placed on some of the vestibular data before they can be properly utilized.[16]

The *nucleus fastigius* belongs to the group of cerebellar nuclei situated in the depths of the corpus cerebelli immediately dorsal to the roof of the fourth ventricle and extending laterally somewhat beyond it. In each side, this group consists

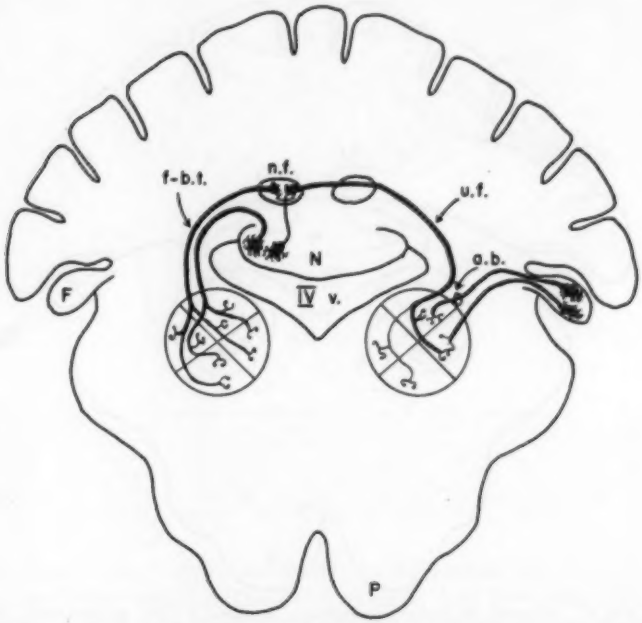


Fig. 5. Efferent cerebellar neurons to the vestibular system. See text for the description. The connections to the reticular formation and medial longitudinal fasciculus were omitted. a.b., "angular bundle" of Lowy; f-b.t., fastigiobulbar tract; u.f., uncinate fasciculus.

of the nucleus fastigius, nucleus globosus, nucleus emboliformis, and nucleus dentatus. The most medial are the fastigial nuclei, sometimes called the "roof or tectal nuclei" because of their position close to the midline in that part of the cerebellum overlying the roof of the fourth ventricle. Like the flocculo-nodular lobe, the nucleus fastigius receives afferent

vestibular fibers from the vestibular nerve and vestibular nuclei (see Figs. 1 and 2) but unlike the flocculo-nodular lobe it is not, however, a predominantly vestibular nucleus. Actually, the main bulk of its afferent fibers comes from all of the cortex of the cerebellar vermis, and through these fibers the nucleus fastigius is strongly influenced by proprioceptive impulses that have reached the Pudkinje cells of the cerebellar vermis through the spino-cerebellar tracts.

The efferent fibers from the fastigial nuclei project to the vestibular nuclei via two bundles, the *direct fastigiobulbar and the crossed uncinate fasciculus or hook bundle* (see Fig. 5). The former passes via the juxtarestiform body and terminates in the ipsilateral vestibular nuclei and reticular formation. The " hook bundle" sweeps across the midline, loops around the superior cerebellar peduncle and nucleus fastigius of the opposite side, and ends in the vestibular nuclei, especially in the lateral nucleus. In normal vestibular reflexes, impulses from the nucleus fastigius decrease or inhibit the discharge from the vestibular nuclei of the opposite side.[17] The efferent fibers from the lingula and uvula project into the fastigial nuclei.

The ascending vestibulo-cerebellar neurons (afferent) and descending cerebello-vestibular neurons (efferent), which run mainly on the lateral walls of the fourth ventricle (medial aspect of the restiform body or juxtarestiform fibers) and also on its roof, have been named by Crosby[18] the "cerebello-vestibular interrelationship." Through it the cerebellum exerts its influence on the central vestibular system. We believe the lack of this influence, due to injury to the connections between the cerebellum and vestibular system, to be responsible for the dysrhythmia in the post-caloric nystagmus.

EARLY CLINICAL OBSERVATIONS.

Occasionally we face a problem such as the following:

A five-year-old girl was sent to one of us with the suspicion of a cerebellar tumor. The neurosurgeon wanted to know the degree of involvement of the midline structures, because such an involvement would make the operation more difficult and also impair the prognosis. Although he knew that the VIIIth nerve was intact, he wanted to know whether there was dysfunction of the central vestibular neurons (central vestibular

nuclei and central vestibular pathways), the cerebellar vermis and the important connection between the two (cerebello-vestibular interrelationship). The dysfunction of the central vestibular neurons would indicate that the tumor had involved the midline structures. The main symptoms and signs in this child were headache, occasional vomiting, slight papilledema, slight unsteadiness and slight impairment of voluntary movements on the right side.

The functional examination of the VIIIth nerve showed the following:

1. Bilateral normal hearing.

2. Slight disequilibrium. The Romberg test was normal, and she did not walk on a wide base, but staggered slightly to the right.

3. The cerebellar tests showed a slight asthenia and dysmetria on the right side, otherwise the coordination was fairly good. There was no intention tremor or dysdiadochocinesia.

4. She had no spontaneous nystagmus or positional nystagmus, and the caloric tests were completely normal.

Comment: The lack of spontaneous and positional nystagmus, and the absence of abnormalities in the caloric responses proved that the central vestibular neurons in the brain stem and cerebellar vermis had not become involved by any tumor. In other words, there was no evidence of involvement of the cerebello-vestibular interrelation.

Operation: An astrocytoma in the right cerebellar hemisphere was found. It was close to the midline but did not involve it.

As we said before, about three years ago one of us began to notice a very peculiar abnormality in the post-caloric nystagmus in patients with tumors in the midline of the posterior fossa. This induced nystagmus beat in the correct direction with normal or longer than normal duration, but the oscillations of the eyes were not regular in amplitude or frequency. In addition, sometimes the induced nystagmus appeared in periods of five to ten seconds, stopped for a few seconds and then reappeared, so we could see large or very large oscillations at a rather high frequency alternating with small and low frequency jerks. We formerly called this abnormality, "irregular post-caloric nystagmus." As we found it only in lesions in the midline of the posterior fossa, we interpreted it as the lack of cerebellar influence over the vestibular nuclei, due to the damage of the cerebello-vestibular interrelationship. Based on our clinical experience and the correlative neurosurgical findings we were able to diagnose lesions in the mid-

line structures of the posterior fossa which involved the cerebello-vestibular pathways.

The following case, in which one of us missed the diagnosis, is good support for the diagnostic value of the irregularity or dysrhythmia in the post-caloric nystagmus.

A four-and-a-half-year-old boy was sent to the Otoneurological Department of the Neurosurgical Institute, Santiago, Chile, in very poor condition. The main symptoms were severe headache, vomiting, papilledema, loss of balance, and very marked generalized asthenia. He was a very restless child and complained and cried most of the time. Functional examination of the VIIIth nerve was somewhat difficult; nevertheless, the hearing was considered normal in both ears. The Romberg test was positive; he walked on a wide base and was constantly wobbling. He practically had a complete loss of balance.

He showed bilateral cerebellar signs.

No spontaneous or positional nystagmus was found, but the nystagmus induced by cold and hot irrigation of both ears was dysrhythmic. For a moment it was large and fast, then it almost stopped, and when it reappeared it was small and slow. It seemed to be a very abnormal post-caloric nystagmus. As the patient was restless, moving about and crying we did not know whether the irregularity in the oscillations of the eyes was actually an abnormality or a product of the child's uneasiness. In order to be certain we decided to use a stronger stimulus, irrigating with 18° water for 60 seconds in each ear. We thought that if the abnormalities that we had just seen were true and not due to faulty observation, they should become obvious using a stronger stimulus. A perfectly normal nystagmus was elicited on either side; therefore, we reported that "there was no involvement in the cerebellar vermis or in the brain stem. The central vestibular neurons were intact."

On the next day one of us was called to the operating room to see a large medulloblastoma which not only invaded the cerebellar vermis but also expanded into the fourth ventricle. This mistake occurred because we had deliberately disregarded the dysrhythmia in the nystagmus elicited with water at 30° and 44° respectively, and considered as valid only the responses at 18°. There is no doubt that irregularity in the post-caloric nystagmus was present when the horizontal semicircular canals were stimulated with water at 30° and 44°, but it disappeared when a stronger stimulus was used. This was due perhaps to a sort of recruitment phenomenon in the cerebello-vestibular interrelationship. This unknown possibility was responsible for our mistake. Since the post-caloric dysrhythmia was present in a patient with a tumor which involved the midline structures in the posterior fossa the clinical value of this otoneurological sign is supported.

DYSRHYTHMIA IN THE POST-CALORIC NYSTAGMUS VERIFIED WITH ELECTRONYSTAGMOGRAPHY.

A. Apparatus and Method.

Following the work of Aschan, et al.,[2] it may be said that electronystagmography is an established clinical aid in vestib-

ular investigation, especially in the evaluation of certain difficult diagnostic problems. The technique has the advantage of supplying a graphic record of the nystagmus which is available for immediate, delayed and repeated examination. It also allows the important comparison and contrasting of the nystagmus with the eyes open and with the eyes closed.

The method utilizes the difference in potential between the retina and the cornea of the eye. In man the retina has a negative charge whereas the cornea has a positive one. When the patient looks to the right the cornea (+ve) of each eye rotates to the right and the retina (–ve) moves to the left. Consequently the outer canthus of the right eye will have a positive charge, and the outer canthus of the left eye will have a negative charge.

This charge persists as long as the eyes are deviated but is cancelled when the eyes return to the resting position. The polarity is reversed by a deviation to the left. Movements of the eyes, in the horizontal plane of the outer canthi, produce a variable direct current potential. If we wish to amplify and record this occurrence we should, in theory, use a D.C. amplifier. Many difficulties arise so that the use of other types of amplifiers may be considered, but their use represents a compromise.

An alternating current amplifier will amplify a change in potential but does not record the duration of the changed state. A capacity coupled amplifier will record a rapid change in potential, but a slow change (as in the slow phase of the nystagmus) is not accurately amplified and recorded because of the effect of the time constant of the apparatus. The shorter the time constant, the greater the inaccuracy of the recording of the slow phase; the longer the time constant, the more accurate the representation of the slow phase.[10] In other words, if the apparatus has a short time constant then the recording will approximate more closely to an A.C. recording, whereas if the T.C. is longer then the recording will approximate more closely to that of a D.C. recording but may be attended by some of the difficulties of a true D.C. recording. Fig. 6 is an example of recordings in which the speed

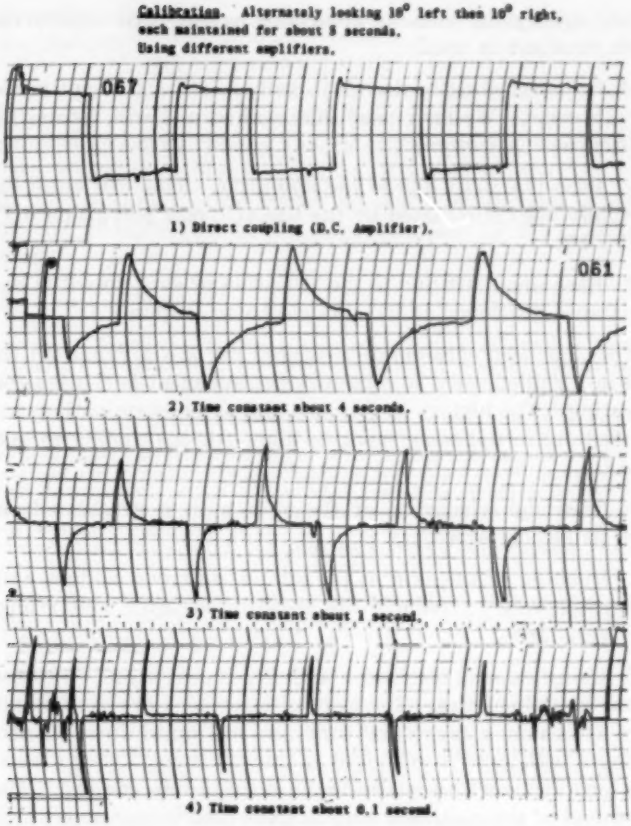


Fig. 6. Calibration using different types of amplifiers. The patient is asked to look to the left for about five seconds and then look to the right for a similar period. The cycle is then repeated. The points for visual fixation, to the left and right are placed so as to subtend an angle of 20° with the patient.

of the slow phase has been reduced to zero, by having the patient fix the gaze to the left for about five seconds and then fix the gaze to the right for about five seconds. This brings out the effect of the time constant of the apparatus, uncomplicated by the slow phase of the normal nystagmus. The error in each part of the graph will be added to the recording

of the nystagmus when an apparatus having each appropriate time constant is used.

A D.C. recording is the ideal method if the difficulties can be overcome. We have used this method and will discuss the difficulties encountered.

1. Base line drift due to the amplifier. This difficulty has virtually been eliminated by the use of Grass polygraph 5 P1 and 5 P3.

2. Base line drift due to the variation of skin potential and resistance developed at the skin electrode coupling.

This has been considerably reduced by: *a.* Carrying out the test in a chilled room to minimize the apparent and insensible sweating. The history is obtained and other examinations are carried out in the same room, to allow for the cooling to take effect.

b. Thorough cleansing of the skin with a grease solvent such as alcohol or ether.

c. Rubbing of the skin at the site of electrode contact with fine sandpaper to remove the keratinized layer and reduce skin resistance.

d. Using calomel electrodes with 1 per cent saline on cotton as the actual contact. The calomel electrodes are very small, they are easily attached by tape and are quite durable, providing a little care is exercised in their storage. They consist of a small tube with a platinum wire fused into one end. The inner end of the platinum wire is immersed in mercury which is then sealed in with a layer of calomel, the final layer being cotton soaked in 1 per cent saline. More cotton soaked in saline is the actual contact with the skin.

Calibration is carried out by asking the patient to alternate his gaze between two vertical stripes set at about ten feet distance and far enough apart to subtend an angle of 20°. If each new position of the gaze during the alterations is maintained for a few seconds before reverting to the previous position, then any drift can be detected by a lack of squareness in the waves. Any large defect in fixation of the gaze

or ocular dysmetria will become evident by a wavering of the plateau.

In some patients a good D.C. recording cannot be made. This may be due to involuntary movements of the face or profuse sweating during the caloric test. In these cases a capacity coupling may be used, but it is realized that the cause of the inaccuracy of the recording is still present but is hidden by the added effect of the time constant of the apparatus used.

B. Clinical Cases.

Case 1. On January 9, 1959, a six-year-old boy was admitted to St. Louis Children's Hospital with the chief complaint of headache and vomiting of about one and one-half months' duration.

In December, 1958, he began to have spells of vomiting in the morning and complained of headaches. These episodes did not seem to be related to meals and the headaches might occur during any part of the day, but particularly at night. These symptoms gradually became more frequent, and because his mother noticed that something appeared to be wrong with his eyes, they appeared somewhat sunken and dark, he was seen by an ophthalmologist who noted bilateral papilledema, and referred him to the hospital. On physical examination he was a very pleasant, co-operative little boy, who did not appear acutely ill.

Examination of his cranial nerves revealed no abnormalities, except bilateral papilledema with hemorrhages. The functional examination of the VIIIth nerve was as follows:

1. Hearing: Normal in both ears.

2. Equilibrium:

a. Romberg: Unsteady, but not positive.

b. Gait: Slight unsteadiness. This was noticed primarily when he turned quickly. He slightly staggered to both sides and only scarcely widened his base while walking.

3. Cerebellum: Slight bilateral asthenia, dysmetria and intention tremor. Dysdiadochocinesis was more marked on the right side.

4. Nystagmus: No spontaneous or positional nystagmus was observed. The caloric tests showed normal vestibular excitability; however, the post-caloric nystagmus showed a definite dysrhythmia. The oscillations of the eye globes were irregular in amplitude and frequency but apparently not in the speed of the slow component.

Fig. 7 shows a normal nystagmus after the conventional caloric stimulation (Hallpike's method). The nystagmus is perfectly regular in amplitude and frequency. Usually this is best seen in the recording between 70″ and 90″ after the start of the stimulation.

Fig. 8 shows the dysrhythmia in the nystagmus induced by caloric testing in this patient. There is a gross irregularity in the amplitude and in the frequency of the eye movements, but the speed of the slow component is about the same.

We considered this type of *abnormality* in the caloric responses to be due to a lack of cerebellar influence over the vestibular nuclei because of damage to the cerebello-vestibular interrelationship.

Our interpretation and comment on this case was the following: "From the otoneurological point of view there is no involvement of the VIIIth nerve, but a marked involvement of the cerebello-vestibular interrelationship shown by a re-

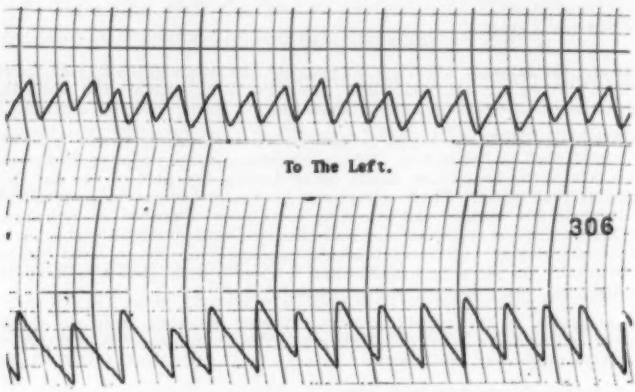
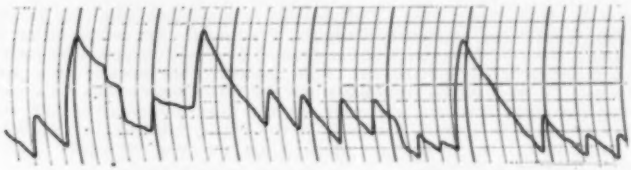


Fig. 7. Irrigation with water at 30° for 40 seconds in the ear elicits nystagmus towards the opposite side. The quick component which designates the direction of the nystagmus is recorded as an almost vertical line. In a normal subject the post-caloric nystagmus shows a good rhythm.

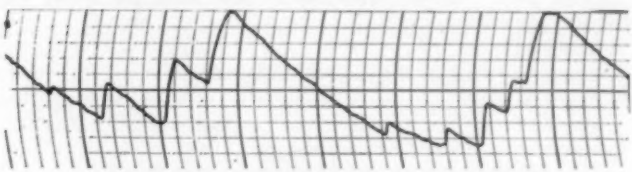
markable dysrhythmia in the nystagmus induced by calorization. This sign plus the disequilibrium and the bilateral cerebellar signs indicate a lesion involving the cerebellar vermis, and the roof and lateral walls of the fourth ventricle but not its floor." Skull X-rays revealed diastasis of the coronal and sagittal sutures. The E.E.G. revealed a slow dysrhythmia with slight left occipital predominance. On January 14, a ventriculography was performed which revealed a mass protruding into the fourth ventricle, and following this a posterior fossa craniotomy was performed. A midline

cystic cerebellar tumor was encountered which proved to be an astrocytoma.

In his operative notes the neurosurgeon wrote: "The tumor lay essentially in the midline—and at the end of the procedure when (he) tried to visualize how much of the tissue there lay between the inferior surface of the tumor and the



Nystagmus Dysrhythmia Due to a Tumor in the Cerebellar Vermis. Before Operation.



Nystagmus Dysrhythmia Due to a Tumor in the Cerebellar Vermis. After Operation.

Fig. 8. Case 1. Dysrhythmia in nystagmus induced by calorization. There is an irregularity in the amplitude and frequency of the eye movements but the speed of the slow component remains about the same in every jerk. Sometimes the nystagmus stops for a few seconds and then reappears. If the cause is a lesion in the cerebellar vermis the dysrhythmia increases when the patient opens his eyes.

After the operation, in spite of the improvement of the patient's condition, the dysrhythmia became more apparent due to the added surgical damage of the cerebello-vestibular interrelation.

fourth ventricle it was realized that there seemed to be only the ependymal layer left over the ventricle."

Two weeks after the operation, the functional examination of the VIIIth nerve was repeated. The disequilibrium had improved and there was no asthenia or dysmetria, only a slight dysdiadochocinesis on the right side. No spontaneous nystagmus was seen. The positional nystagmus and postural vertigo were not tested because of the soreness of the wound.

Actually the patient had done extremely well after the operation, and the funduscopic examination revealed the discs to be flat.

The post-caloric nystagmus, however, showed a greater dysrhythmia (see Fig. 8) which is easy to understand if we realize that the neurosurgeon had dissected to the roof of the fourth ventricle in order to extirpate the tumor.

Case 2. In October, 1959, a 38-year-old woman was admitted to the medical department of Barnes Hospital, St. Louis. Six weeks prior to admission she had been well but developed a severe occipital headache which lasted an hour, leaving her "light-headed." She became dizzy and nauseated on lying down, especially on the right side. This improved after a few days and she was well for the next four weeks, then the nausea returned in certain positions of the head, resulting in vomiting. She had had this for about one week when she was admitted. There were no hearing problems.

Functional Examination of the VIIIth Nerve.

1. Hearing tests: Normal thresholds for pure tones and speech with normal discrimination.

2. Equilibrium:

a. Romberg: Slightly unsteady but not positive.

b. Gait: A little unsteady becoming a little worse with the eyes closed.

3. Cerebellum: No lateral cerebellar signs.

4. Positional nystagmus and postural vertigo.

There was no spontaneous nystagmus. There was slight vertical (downward) nystagmus with the head extended (hanging) and also with the head over the right shoulder. There was marked vertigo and the nystagmus persisted until the patient vomited. Type 2.

5. Caloric tests:

The nystagmus was within normal limits as regards amplitude and duration; however, there was a marked dysrhythmia.

Comment: From the otoneurological point of view there is no involvement of the VIIIth nerve. The cochlear and vestibular excitability is normal. There is a central vestibular syndrome characterized by: *1.* Postural vertigo with vomiting and positional nystagmus Type II. *2.* Dysrhythmia in the post-caloric nystagmus and *3.* disequilibrium.

In view of this one of us (M.H.S.) reported that "the findings suggest a midline cerebellar lesion." The patient was treated by intravenous fluids to correct an ionic imbalance. The patient improved very quickly. Three days later there was no postural nystagmus, but there was still a little postural vertigo. The dysrhythmia was much less but still present (see Fig. 9). There were no other neurological signs to suggest a posterior fossa lesion and the patient was discharged home.

She improved for several weeks but was still a little unsteady. She then developed increasing headache with weakness and was readmitted to hospital with bilateral papilledema.

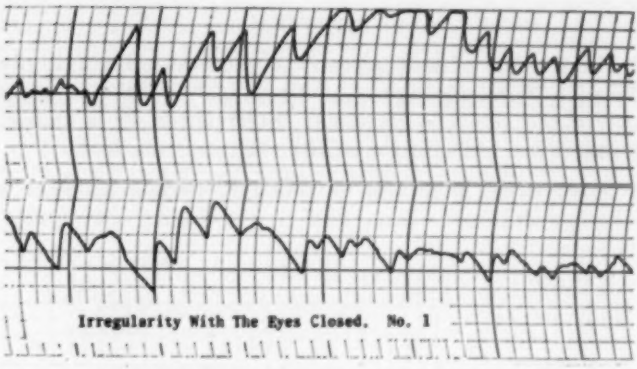


Fig. 9. Case 2. October, 1959. Slight dysrhythmia still present though patient had improved after therapy.

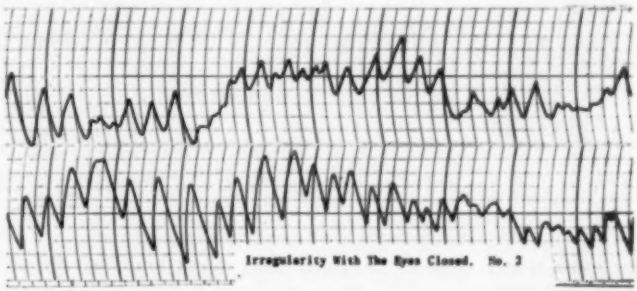


Fig. 10. Case 2. February, 1960. Eyes closed. Dysrhythmia more marked than previously with eyes closed.

We saw the patient on February 11, 1960, and found her much worse than before. She had a spontaneous nystagmus in all directions of the gaze, which was altered in quality by changes of head posture. Type I. Very slight bilateral cerebellar signs were verified, and the dysrhythmia in the post-caloric nystagmus was clearly present (see Figs. 10 and 11). The hearing was still normal. In view of these findings the diagnosis of a central vestibular syndrome due to a lesion in the cerebello-vestibular interrelation was confirmed.

Later that day neuro-surgical air studies were performed and a craniotomy was done. The surgeon found an ependymoma and wrote ". . . I cleaned out the tumor which had replaced the vermis and removed a large nodule which had dilated the upper part of the fourth ventricle." The tumor extended along the lateral margin of the fourth ventricle on both sides, more on the right than on the left.

DISCUSSION.

The purpose of this paper is to emphasize dysrhythmia in the post-caloric nystagmus as a possible clinical sign of damage to the cerebello-vestibular interrelation by a tumor or degenerative lesion of the midline of the cerebellum.

Dysrhythmia may also be found in normal subjects who exhibit spontaneous large and slow swinging movements of

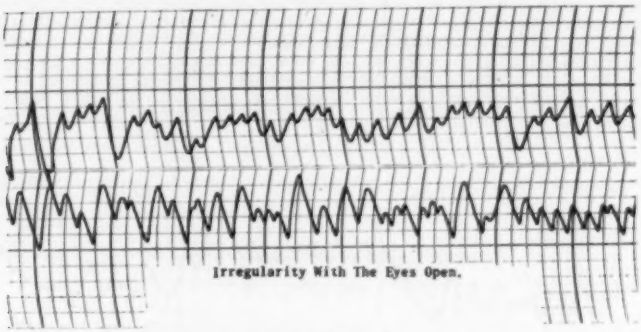


Fig. 11. Case 2. February, 1960. Eyes open. Dysrhythmia more marked than with eyes closed.

the eyes when closed. Aschan[2] has described two types of normal eye movements. One consists of small irregular eye movements which do not interfere with post-caloric nystagmus, and the other consists of slow swinging movements, in which each swing lasts several seconds. The super-position of the induced nystagmus over the swinging movement can simulate a dysrhythmia. We believe that the following case clearly illustrates this point.

A 36-year-old woman was sent to us on May 1, 1959, from the Neurological Department, Washington University, St. Louis, for functional evaluation of the VIIIth nerve because she was complaining of hearing loss and dizziness. She had recently had a few mild epileptic seizures. The E.E.G. showed a focus in the left temporal lobe. Some of her relatives were epileptic. For five months she had been under treatment with Dilantin® (0.1 gm. 3 times a day) and phenobarbital (100 mg. at bedtime, daily) and during this time she had been free of attacks.

The hearing was normal for pure tones and speech. She had normal

equilibrium, normal cerebellar function, no spontaneous or positional nystagmus, and normal vestibular excitability. The caloric tests, however, showed a marked dysrhythmia in the nystagmus (see Fig. 12). There was a marked irregularity in the amplitude and frequency of the eye oscillations only when they were closed, but as soon as they were opened the dysrhythmia disappeared, and the nystagmus became perfectly rhythmic (see Fig. 13).

Our previous experience with electronystagmography had taught us that the spontaneous slow swinging movement of the eyes could simulate a dysrhythmia in nystagmus induced by calorization and we also knew

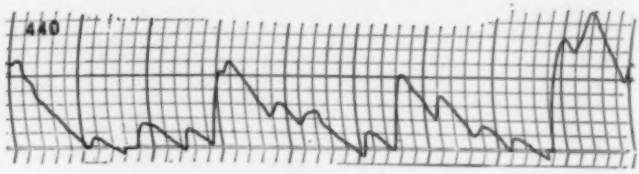


Fig. 12. Dysrhythmia due to the superposition of the nystagmus induced by caloric stimulation on spontaneous eye movements.

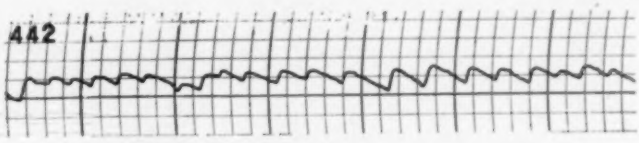


Fig. 13. The dysrhythmia not caused by a lesion in the cerebello-vestibular connections disappears when the patient opens her eyes.

that this disappeared when the patient opened the eyes, because of fixation of the gaze.

The perfect equilibrium and the absence of neurological symptoms in our patient, did not support the possibility of a lesion in the cerebello-vestibular interrelation. We thought, therefore, that the only explanation of the dysrhythmia would be the existence of spontaneous slow swinging of the eyes when closed. Next we ran the electronystagmograph without caloric stimulation in order to detect eye movements. Spontaneous large and slow swinging movements were recorded (see Fig. 14) which vanished when the patient opened her eyes (see Fig. 15).

We attributed the eye movements to the daily intake of phenobarbital.

We consider the dysrhythmia in nystagmus induced by the

caloric tests as an otoneurological sign of a destructive lesion in the cerebello-vestibular interrelationship. We have verified it in medulloblastomas, astrocytomas, ependymomas, and recently in an advanced case of multiple sclerosis (see Fig. 16) which, therefore, must be considered in the differential diagnosis. Of course, it also may be present in other lesions

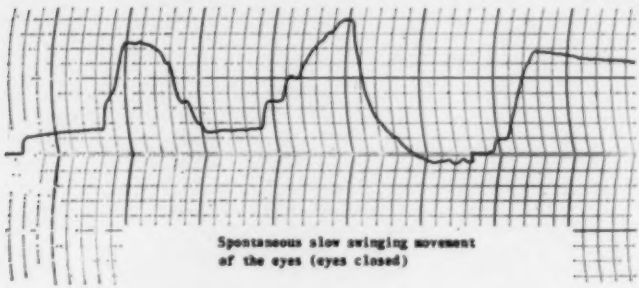


Fig. 14. Eyes closed. Large slow swinging of the eyes attributed to daily intake of phenobarbital.

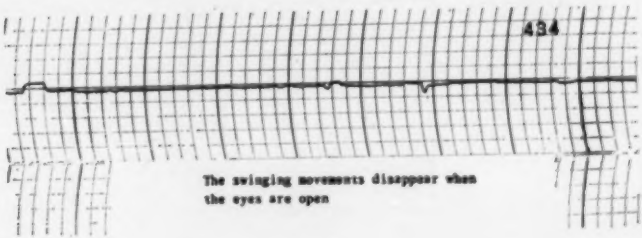


Fig. 15. Eyes open. Swinging movements disappeared due to eye fixation.

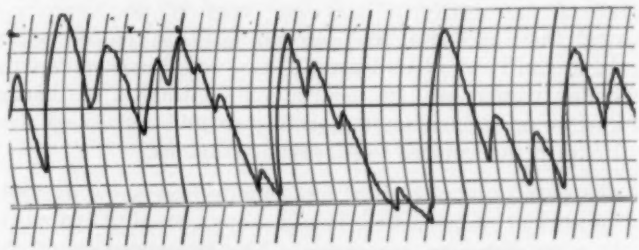
involving this structure. Dysrhythmia resulting from the superposition of the induced nystagmus over spontaneous movements of the eyes must be excluded.

If the cause is a lesion in the midline structures in the posterior fossa, the dysrhythmia will be present with the eyes closed and open. In addition, electronystagmography has

shown us that the dysrhythmia may be accentuated with the eyes open.

If the cause is the slow swinging of the eyes which is occasionally encountered in normal individuals, the dysrhythmia will be present only with the eyes closed, and it will disappear with the eyes open, because the swinging movement stops with fixation of the gaze.

Another source of error in the evaluation of this sign is the inhibition of the nystagmus with the eyes open due to volun-



Nystagmus Disrhythmia Due To Multiple Sclerosis

Fig. 16. This patient had a very marked disequilibrium, she could scarcely walk; she had bilateral celebellar symptoms, had spontaneous nystagmus in several directions of the gaze, and Type I positional nystagmus (non-paroxysmal). The vestibular excitability was normal but the post-caloric dysrhythmia evidenced a lesion in the cerebello-vestibular connections.

tary fixation of the visual axis in order to avoid the unpleasant sensation of objective displacement. Any dysrhythmia due to variation of the patient's effort at fixating the visual axis must be excluded, but this variation would occur only with the eyes open. Irregular movements due to local lesions in the orbit also must be differentiated.

SUMMARY.

1. The clinical evaluation of the vestibular system is based specifically on the examination of the nystagmus.

2. A brief account of spontaneous nystagmus, positional

nystagmus, and abnormalities in the post-caloric nystagmus is given.

3. One of these abnormalities is the dysrhythmia in nystagmus induced by calorization which has been consistently verified in patients with tumors in the midline structures in the posterior fossa.

4. We believe that the post-caloric dysrhythmia is produced by damage to the cerebello-vestibular interrelationship. This consists of the afferent and efferent connections between the cerebellum and the vestibular system which mainly course on the lateral and superior walls of the fourth ventricle (medial aspect of the restiform body and roof of the ventricle). Through these ascending and descending fibers the cerebellum exerts its influence (inhibition, tonus, coordination) on the vestibular responses. Its destruction by tumors or disease diminishes or suppresses this influence and results in dysrhythmia in the induced vestibular nystagmus.

5. Electronystagmography occasionally may show dysrythmia in normal subjects with spontaneous swinging eye movements when the eyes are closed. The superposition of the induced nystagmus over the swinging movement might simulate a dysrhythmia. The differential diagnosis, however, is easily made. The spontaneous swinging movements seen with the eyes closed disappear as soon as the patient opens his eyes, due to fixation of the gaze; therefore, if the dysrhythmia is due to such movements, it will disappear as soon as the eyes are opened. On the other hand, if it is caused by a lesion in the midline structures in the posterior fossa, the dysrhythmia will be present with the eyes closed and open. Apparently with the eyes open it is even larger.

ACKNOWLEDGMENTS.

We are greatly indebted to Dr. Theo. E. Walsh, in whose department this work was largely carried out; to Dr. Cesar Fernández of the University of Chicago for the drawings of the vestibulo-cerebellar pathways as well as for his help in the neuroanatomical description of the cerebello-vestibular interrelation; to Dr. Leonard Furlow and Dr. William Coxe

of the Neurosurgical Department of Washington University, St. Louis, Mo., and to Dr. Reinaldo Poblete of the Neurosurgical Institute, Santiago, Chile, who allowed us to study some of the cases presented here.

REFERENCES.

1. Nylén, C. O.: Positional Nystagmus. A Review and Future Prospects. *Jour. Laryngol. and Otol.*, 64:295-318, June, 1950.

2. Aschan, G.; Bergstedt, M., and Stahle, J.: Nystagmography. Recording of Nystagmus in Clinical Neuro-Otological Examinations. *Acta Oto-Laryngol.*, Supp. 129, 1956.

3. Riesco-MacClure, J. S.: Es el Vertigo Aural de Origen Exclusivament Periférico? *Rev. Otorrinolaringol.*, 17:42-54, Dec., 1957.

4. Citron, L., and Hallpike, C. S.: Observations Upon the Mechanism of Positional Nystagmus of the So-Called "Benign Paroxysmal Type." *Jour. Laryngol. and Otol.*, 70:253-259, May, 1956.

5. Fernández, C.; Lindsay, J. R., and Alzate, R.: Postural Nystagmus Due to Localized Cerebellar Lesions in the Cat. *Acta Oto-Laryngol.*, 50: 287-291, May-Aug., 1959.

6. Riesco-MacClure, J. S.: Nistagmus: Su Valor en el Diagnóstico Otoneurológico. *Rev. Otorrinolaringol.*, 15:18-34, April, 1955.

7. Fernández, C.; Lindsay, J. R., and Alzate, R.: Experimental Observations on Postural Nystagmus. II. Lesions of the Nodulus. In press.

8. Riesco-MacClure, J. S., and y Martinez, A.: Nistagmus Pervertido: Estudio Clínico e Histopatológico. *Rev. Otorrinolaringol.*, 17:1-5, June, 1957.

9. Fitzgerald, G., and Hallpike, C. S.: Studies in Human Vestibular Function: I. Observations on Directional Preponderance ("Nystagmusbereitschaft") of Caloric Nystagmus Resulting from Cerebral Lesions. *Brain*, 65:115, June, 1942.

10. Nylén, C. O.: The Otoneurological Diagnosis of Tumors of the Brain. *Acta Oto-Laryngol.*, Supp. 33, 1939.

11. Aubry, M.: "Oto-Neurologie. Technique et Interpretation des Examens Labyrinthiques." Masson et Cie, Paris, 1944.

12. Lorente de No, R.: Analysis of the Activity of the Chains of Internuncial Neurons. *Jour. Neurophysiol.*, 1:207-244, 1938.

13. Dow, R. S.: The Fiber Connections of the Posterior Parts of the Cerebellum in the Rat and Cat. *Jour. Comp. Neurol.*, 63:527-548, 1956.

14. Dow, R. S.: Efferent Connections of the Flocculo-nodular Lobe in Mulatta. *Jour. Comp. Neurol.*, 68:297-305, 1938.

15. Jansen, J., and Brodal, A.: "Aspects of Cerebellar Anatomy." J. Grundt Tanum, Oslo, 1954.

16. Krieg, W. J. S.: "Functional Neuroanatomy." The Blakiston Co., New York, 1953.

17. Peele, T. L.: "The Neuroanatomical Basis for Clinical Neurology." McGraw-Hill Book Co., New York, 1954.

18. Kahn, E. A.; Bassett, R. C.; Schneider, R. C., and Crosby, E. C.: "Correlative Neurosurgery." Charles Thomas, Springfield, 1955.

19. McLay, K.; Madigan, M. E., and Ormerod, F. C.: Electrical Nystagmography and Its Use in the Clinical Investigation of Vestibular Function. *Jour. Laryngol.*, 72(1).

PSEUDO-OTOSCLEROSIS.*†

VICTOR GOODHILL, M.D.,

Los Angeles, Calif.

The patient with an intact and mobile tympanic membrane, patent Eustachian tube, negative Rinné, and excellent air-bone gap is usually correctly called an otosclerotic, but he may not have otosclerosis at all.

A number of conditions can occur which will mimic otosclerosis. Thus "Pseudo-otosclerosis" is not a clinical entity but a concept which must constantly be in the mind of the otologist who plans a tympanotomy for a case of supposed otosclerosis.

Under the heading of "Pseudo-otosclerosis," I have obviously not included many other conductive lesions involving tympanic disease in which there may occur tympanic perforations, otorrhea, polyposis, and other signs of active tympanic disease. In order to qualify as a "pseudo-otosclerotic" an ear must have an intact mobile tympanic membrane, a significant conductive hypacusis, and all of the other criteria described above. The vast majority of these cases are unilateral. While unilateral true otosclerosis certainly occurs, the differential diagnostic study should be especially searching in unilateral cases.

In presenting this concept for consideration it is really the intention of the author to clarify the differential diagnosis of so-called clinical otosclerosis. The following groups of cases and their illustrative examples are by no means intended to constitute a complete compendium of all such diagnostic possibilities. There are other examples which could be added to this list, but this group consists only of those significant types of cases which have come to the attention of the writer

*Read at the meeting of the Western Section, American Laryngological, Rhinological and Otological Society, Inc., Denver, Colo., Jan. 22, 1960.

†From the Department of Otolaryngology, Cedars of Lebanon Hospital, and The Western Foundation for Hearing Research.

Editor's Note: This manuscript received in The Laryngoscope Office and accepted for publication Feb. 25, 1960.

and his colleagues. In this presentation, each clinical group will be illustrated by only one clinical case record in most instances, although in some of the categories multiple examples are present in our files.

In classifying the various conditions which can mimic clinical otosclerosis, it was decided to group them in an essentially anatomical manner since all of these conditions produce similar physiological sequellae.

I. Total Ossicular Chain Fixation.

A. Chronic glue ear with adhesive fibrosis.
B. Granulomatous otitis.
C. Diffuse fibrosis.
D. Tympano-sclerosis.
E. Pan-osteo-arthritis of ossicular chain.

II. Diseases of the Incus.

A. Traumatic dislocation of the incus.
B. Fixed incus.
  1. Incus annulus fusion.
  2. Incudo-malleolar fusion with cholesteatoma.
C. Incus atrophy.
D. Lenticular process necrosis.

III. Non-Otosclerotic Diseases of the Stapes.

A. Paget's disease.
B. Osteogenesis imperfecta.
C. Tympano-sclerosis.
D. Footplate arthritis.
E. Peristapedial tent.
F. Congenital fixation.

IV. Anomalies of Ossicles and Windows.

I. TOTAL OSSICULAR CHAIN ANKYLOSIS.

Among the sequellae of chronic otitis media there is universal awareness of the dramatic problems of perforations, suppurations, cholesteatomata, polypi, etc. The apparently innocuous sequel of diffuse fibrosis rarely produces symptoms

unless its severity immobilizes the ossicular chain. In such instances a conductive hypacusis ensues. Such an involvement may cause hearing losses from 10 db to 60 db. Obviously, when the loss reaches 35-40 db it becomes significant otologically in the differential diagnosis of otosclerosis.

A number of forms of diffuse fibrosis may occur of which three different examples are presented.

In addition, other lesions can cause total ossicular chain ankylosis. Tympano-sclerosis, possibly a special type of fibrosis involving the tympanic muco-periosteum is exemplified by a case. Pan-osteo-arthritis of the ossicular chain can also completely immobilize it and simulate far advanced otosclerosis. This is illustrated by a case.

A. Chronic Glue Ear with Adhesive Fibrosis.

Serous effusion of the middle ear has become a very serious cause of conductive hearing loss and the frequency of this condition is undoubtedly increasing. One of the final sequellae of an apparently innocent serous effusion is the so-called glue ear in which very thick exudate of almost solid consistency fills the middle ear. This is another variant of chronic low grade otitis media.

In some cases the glue ear may persist for many, many years, and may be accompanied by co-existent tympanic fibrosis. In many cases it undoubtedly is a precursor of total tympanic fibrosis; however, in some cases it is possible for both glue-like fluid and the fibrotic tissue to co-exist and to contribute in a parallel way by ossicular fixation and window blockade to a major conductive hypacusis.

Case 1. L.K., a 30-year-old white female, gave the history of a hearing loss in the left ear since early childhood. She denied any attacks of otitis media and denied any myringotomies or any type of therapy to the left ear. Examination revealed that the left tympanic membrane was intact but somewhat dull in appearance and slightly retracted. It was, however, mobile and there was evidence of good tubal function on politzerization. No definite fluid could be seen although a suggestion of fluid appeared on several examinations. X-rays of the mastoids revealed a definitely sclerotic and infantile left mastoid. There was a questionable history of family deafness. There were no other significant findings except for low grade chronic tonsillitis.

Audiometric examination revealed a marked left conductive hypacusis.

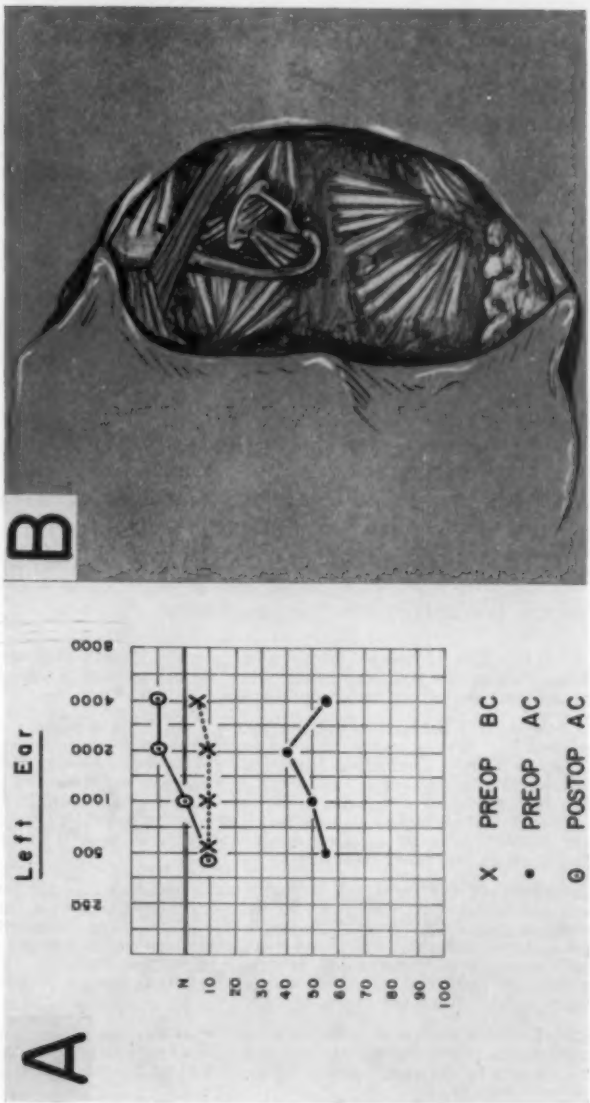


Fig. 1. Chronic glue ear with adhesive fibrosis. A.—Audiogram. B.—Tympanotomy findings.

Tuning fork tests showed a negative Rinné on the left with the Weber referred to the left.

A left exploratory tympanotomy revealed a moderate amount of thick glue-like secretion in the hypotympanum, accompanied by large bands of scar tissue with one very dense fan shaped band between the incus and the annulus. A thick fibrous band filled the round window niche. The stapes was quite firmly fixed by bands of scar tissue between the neck, crura, and the promontory. The footplate was mobile. Following removal of the glue secretion and dissection of all of the bands of scar tissue her hearing returned completely to normal on the operating table. There was no evidence of otosclerosis and an excellent round window reflex was obtained on palpation of the stapes (see Fig. 1).

B. Granulomatous Otitis.

The formation of granulomata and granulomatous polypi is not a rare aspect of the pathologic course of chronic otitis media. In most cases such granulomatous otitis is accompanied by similar changes in the mastoid antrum and periantral cells. It is possible for such changes to represent only a transitional stage in the progression toward ultimate irreversible fibrosis; however, this granulomatous phase may continue for a long time, undoubtedly for years and years before fibrosis takes place. When the granulomatous process is sufficiently extensive, it may create a mechanical impedance involving the entire ossicular chain and produce a conductive hypacusis as is illustrated in the case below.

Case 2. G.R. This 42-year-old white male gave the history of progressive hearing loss in the right ear of six years' duration. There was also a history of deafness in his paternal relatives.

The middle ear inflated well on politzerization. The Rinné response was negative, and the Weber was referred to the right side. Audiometric studies showed a right conductive hypacusis. There were no significant abnormalities in the left ear. There was a moderate deflection of the septum to the right and there was evidence of a low grade chronic tonsillitis. Roentgen studies showed a normal well pneumatized left mastoid. The right mastoid was mixed, pneumatic and diploic, and there was diffuse haziness in the pneumatic areas.

On exploration of the right middle ear via tympanotomy under local anesthesia the middle ear was found to be completely filled with thick granulomatous polypi in which the ossicular chain was completely embedded and immobilized. Following meticulous removal of the granulomatous tissue the ossicular chain returned to normal mobility. The stapes was found to be completely normal and mobile following stripping of the granulomata from the crura.

In spite of visible return of mobility to the ossicular chain there was no demonstrable improvement in hearing audiometrically; however, within two weeks he obtained marked improvement of hearing which has persisted (see Fig. 2).

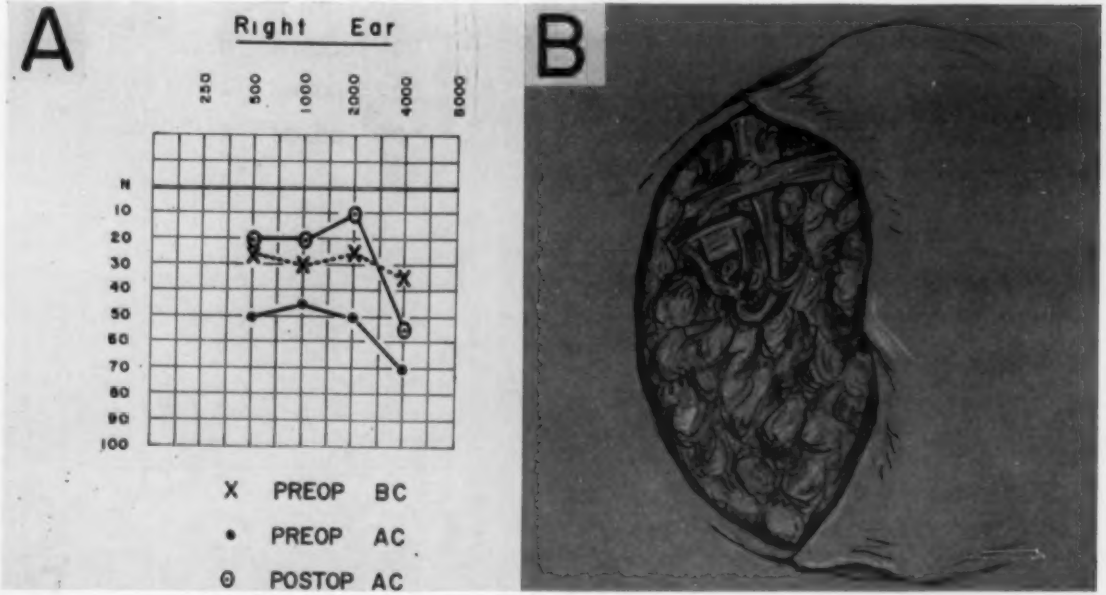


Fig. 2. Granulomatous otitis. A.—Audiogram. B.—Tympanotomy findings.

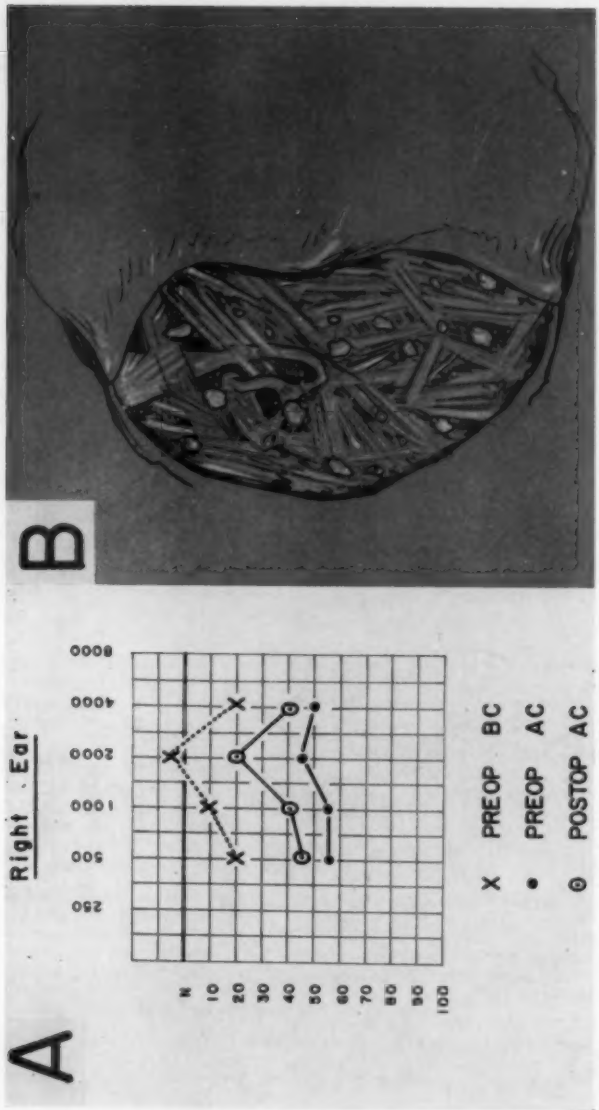


Fig. 3. Diffuse fibrosis. A.—Audiogram. B.—Tympanotomy findings.

C. Diffuse Fibrosis.

The most common version of chronic otitis media in the presence of an intact tympanic membrane is the slow development of a diffuse pan-fibrosis. Such fibrotic changes can effectively fix the entire ossicular chain as is demonstrated in the following case.

Case 3. J.O., a 29-year-old white male, gave the history of recurrent ear infections in infancy and was aware of a major bilateral hearing loss since early childhood. There was no familial history of deafness.

Examination revealed both tympanic membranes to be intact and moderately scarred but mobile on pneumatic massage. Both Eustachian tubes were patent on politzerization. Both Rinné responses were negative. There were no significant nasal or pharyngeal findings. X-rays revealed infantile non-pneumatized mastoids bilaterally.

A right exploratory tympanotomy revealed the middle ear completely filled with diffuse fibrotic scars. The incus was bound anteriorly and posteriorly by dense scars and the same types of scars were present in the peri-footplate regions. With great difficulty all of the visible bands of scar tissue were dissected free, following which palpation revealed a perfectly mobile stapes and following which there was a marked improvement in hearing. This improvement, however, did not persist and an audiogram six weeks postoperatively showed only a moderate improvement in hearing (see Fig. 3).

D. Tympano-sclerosis.

Tympano-sclerosis, a recently described type of chronic otitis media, is not a rare finding in tympanoplastic surgery. Onion-like scales of keratin seem to grow throughout the tympanic cavity and a keratinization and hyalinization process may involve both mucosa and periosteum. It may further involve the bone of the otic capsule and may destroy any or all of the ossicles. It is most commonly diffuse in the tympanic cavity and thus produces a total ossicular fixation as is described in the following case:

Case 4. J.L., a 52-year-old white female, had a history of recurrent bilateral otorrhea since childhood following scarlet fever. Examination revealed intact but scarred tympanic membranes bilaterally. The left tympanic membrane was moderately mobile and showed a calcified plaque anteriorly. The Eustachian tube function was normal on politzerization. The Rinné response was negative and audiometry showed a typical conductive hypacusis. X-rays showed acellular undeveloped infantile mastoids bilaterally.

A left exploratory tympanotomy revealed a middle ear filled with scar tissue bands which were attached to onion-like lamellae of sclerotic tissue covering the manubrium of the malleus, the long process of the incus and the stapedial crura. Other lesions were present over the facial nerve and seemed to involve the otic capsule throughout the promontory region and

throughout the region of the niche of the round window. There was total fixation of the ossicular chain and in view of these findings no definitive surgical procedure was carried out. There was no improvement in hearing (see Fig. 4).

E. Pan-Osteo-Arthritis of Ossicular Chain.

Among the lesions responsible for stapes ankylosis is a true osteo-arthritis; however, it is possible for such an arthritis to involve the entire chain and to create not only a fixed stapes but a fixed incudo-malleolar joint and a fixed incudo-stapedial joint as is exemplified in the following case:

Case 5. P.G., a white male, aged 63, gave the history of a bilateral hearing loss since childhood which continued to become progressively worse, requiring the use of a hearing aid during the past 38 years. There is a very strong family history of otosclerosis.

Examination revealed bilateral intact tympanic membranes. Both were mobile and both Eustachian tubes were patent on politzerization. Both Rinné responses were negative. There were no significant nasal or naso-pharyngeal findings with the exception of moderate low grade chronic tonsillitis. X-rays revealed well pneumatized mastoids bilaterally, but both sides showed equal periantral sclerosis.

Audiometric studies revealed evidence of a very profound bilateral mixed deafness with a major neural component. There was, however, a persistent negative Rinné response to the lower tuning forks bilaterally. A diagnosis of far advanced bilateral otosclerosis with cochlear degeneration was made and a right exploratory tympanotomy was advised, with a very poor prognosis.

A right tympanotomy exploration revealed that the incus was completely fixed by incudo-malleolar fusion. The incudo-stapedial joint was ossified. Both crura were attached to the promontory by bony union and there was a marked anterior peribasal ankylosis involving a good deal of the anterior crus and footplate. The long process of the incus was amputated and the stapes crura were removed. A polyethylene tube was placed between the posterior aspect of the footplate and the medial aspect of the tympanic membrane following which the posterior one-third of the footplate was mobilized by chisel cuts. There has been no significant gain in hearing (see Fig. 5).

II. DISEASES OF THE INCUS.

A number of conditions involving the incus exclusive of the stapes can produce major conductive hypacuses simulating otosclerosis. These may include traumatic dislocation of the incus, fixed incus, incus atrophy, and lenticular process necrosis. Each of these may occur in a number of forms of which only major examples will be cited.

A. Traumatic Dislocation of the Incus.

While it is certainly possible for otosclerosis to develop in

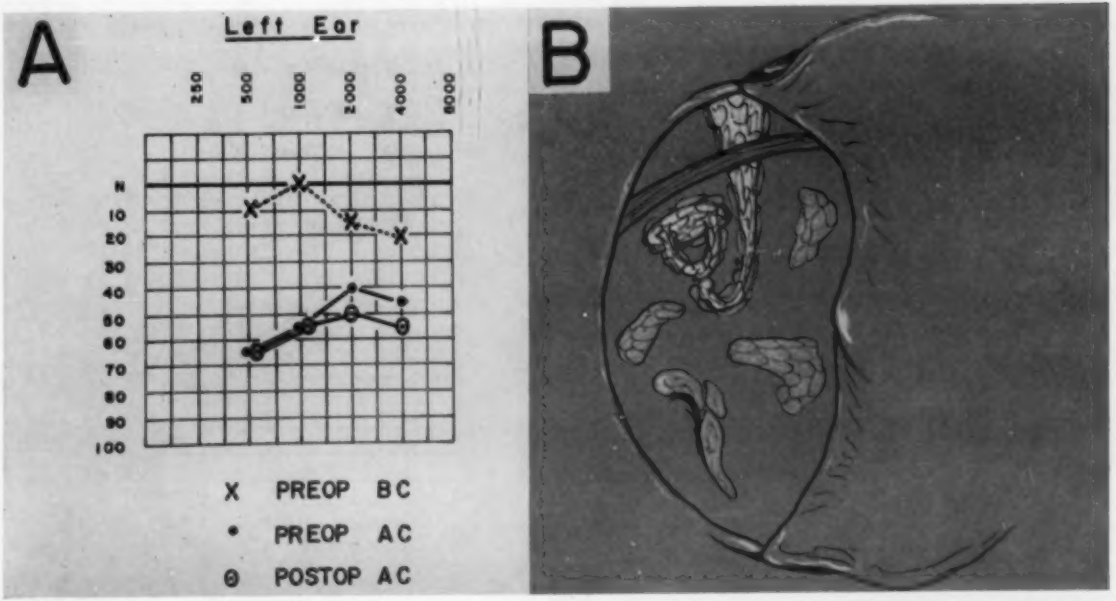


Fig. 4. Tympanosclerosis, diffuse. A.—Audiogram. B.—Tympanotomy findings. (Note tympanosclerotic lesions on the incus, stapes and on diffuse areas of the otic capsule.)

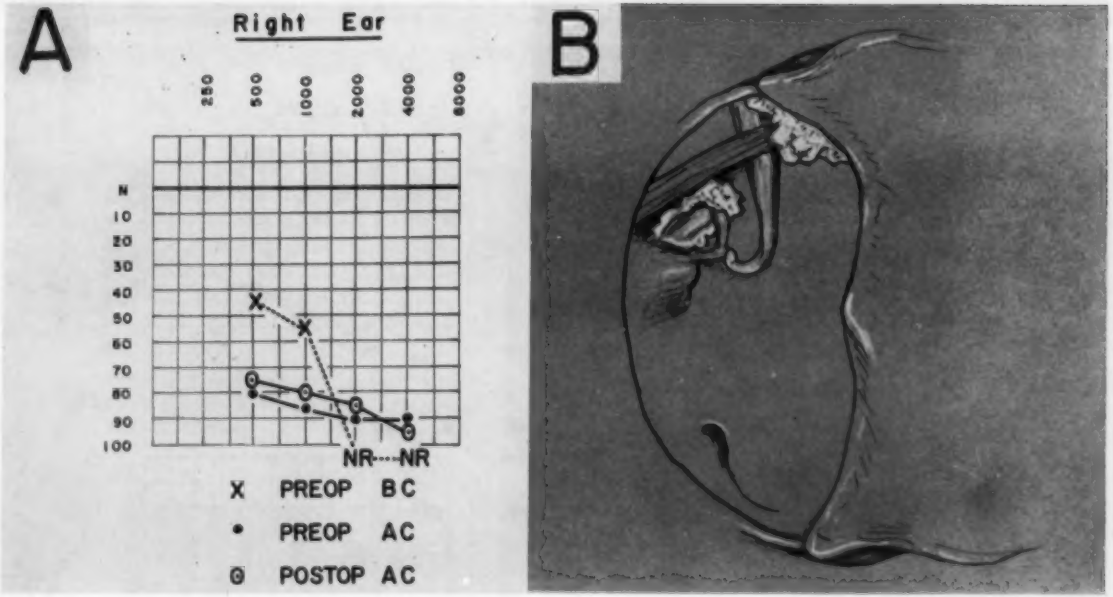


Fig. 5. Pan-osteo-arthritis of ossicular chain. A.—Audiogram. B.—Tympanotomy findings.

an ear which had been the seat of acute otitis media and acute mastoiditis in infancy, the otologist should be wary of the presumptive otosclerotic who gives a history of an infantile mastoidectomy and who shows a small postauricular scar. Not infrequently such a supposed otosclerotic has a perfectly mobile stapes and a traumatically dislocated incus. It is not unusual for this to have occurred bilaterally.

Case 6. I.L. This 28-year-old white male gave a history of a bilateral mastoidectomy at the age of nine months following otitis media secondary to scarlet fever. He has been aware of a hearing loss since childhood and has worn a hearing aid for many years.

Examination revealed bilaterally intact tympanic membranes. Each tympanic membrane showed moderate scarring and small calcified plaques, but both were mobile and both ears showed evidence of good tubal function. There was no fluid in either ear. Small healed postauricular incisions were present bilaterally. Both Rinné responses were negative and audiometric examination revealed evidence of bilateral conductive hypacusis. X-rays surprisingly revealed bilaterally normal and extensively pneumatized mastoids.

Right exploratory tympanotomy revealed a somewhat atrophic incus in the epitympanum, with no contact with either malleus or stapes. It was removed. The stapes was perfectly mobile and normal in every respect. A polyethylene strut was placed on the capitulum of the stapes and allowed to contact the posterior half of the tympanic membrane. There was an immediate improvement in hearing which has persisted (see Fig. 6).

B. Fixed Incus.

The incus can become fixed in a number of ways, and in each situation it will result in immobilization of the ossicular chain and a conductive hypacusis regardless of a mobile stapes and a normal round window membrane. Two examples of fixed incus conditions will be presented.

1. Incus Annulus Fusion.

In tympanic fibrosis of long duration eventual osteogenetic activity supercedes the fibrosis in many cases.

Case 7. I.L., a 65-year-old white female, with diabetes under control, presented herself with a bilateral conductive hypacusis. The right tympanic membrane was intact, translucent and mobile, but showed several small calcified plaques. The right Eustachian tube was patent on politzerization. X-rays revealed bilaterally infantile non-pneumatized mastoids.

Exploratory tympanotomy revealed a middle ear with tremendously thickened mucosa and large strands of fibrous tissue between the three ossicles, the tympanic membrane, and the promontory. The incus was completely immobilized by a firm bony bridge between it and the posterosuperior aspects of the annulus. The stapes appeared to be perfectly

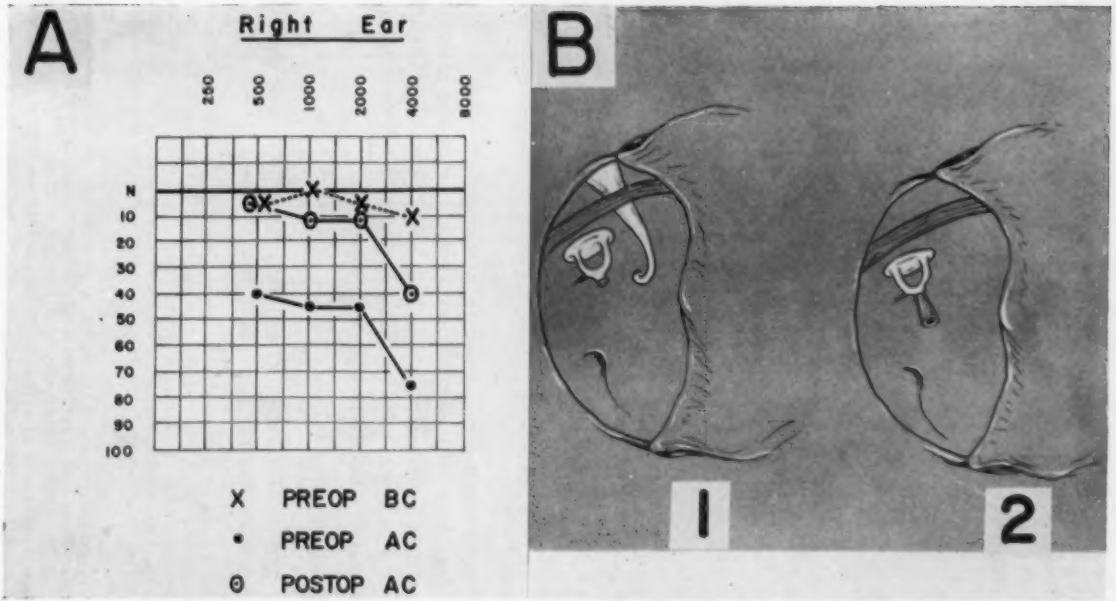


Fig. 6. Traumatic dislocation of the incus. A.—Audiogram. B.—Tympanotomy findings. 1. Note discontinuity between dislocated incus and stapes; 2. Polyethylene prosthesis on stapedial capitulum.

mobile. An attempt was made to resect the bony bridge between the incus and the annulus but this attempt failed, even after extensive annulus removal. Accordingly, the lenticular process and a portion of the long process of the incus were removed and a myringostapediopexy was performed by placement of invaginated tympanic membrane onto the stapedial capitulum. This was followed by marked improvement in hearing (see Fig. 7).

2. Incudo-Malleolar Fusion with Cholesteatoma.

It is an old laryngological cliche that a patient with hoarseness due to carcinoma of the larynx can also have tuberculosis and syphilis of the larynx. It is similarly true that a patient who has otosclerosis can have other otologic diseases such as illustrated in the case below.

Here we are dealing with a case of bilateral progressive deafness in which there was a marked otosclerotic lesion on the left side; however, the left ear also contained a silent hidden cholesteatoma which had produced incudo-malleolar fusion. The fixed incus on this side added to the impedance problem, and the solution will be described below.

Case 8. A.L., a 36-year-old white male, gave a history of progressive bilateral hearing loss of 20 years' duration. He had no history of otitis media and gave no family history of deafness.

Examination revealed that both tympanic membranes were intact, moderately scarred and somewhat fibrotic with slightly impaired mobility. Both Rinné responses were negative and the audiometic studies revealed a bilateral conductive hypacusis and an approximate 55 db loss in each ear with excellent bone conduction. There were no significant nasal or nasopharyngeal abnormalities. X-rays revealed bilaterally diploic mastoids with moderate bilateral periantral sclerosis.

Left exploratory tympanotomy revealed a completely fixed incus and a solitary epitympanic monolocular cholesteatoma with extension into the attic. The incus was fixed because of incudo-malleolar fusion. The stapes was also fixed by a fairly large anterior otosclerotic tumor. Because of the multiple problems no definitive surgical procedure was performed on this ear at this stage. At a subsequent date an endaural left radical mastoidectomy was carried out with removal of the cholesteatoma and with the creation of a classical fenestra in the horizontal semicircular canal. The fenestra was closed by a split thickness graft. A satisfactory gain in hearing was obtained.

At a subsequent stage a right exploratory tympanotomy was performed. An enormous anterior otosclerotic tumor was visualized. It almost completely filled the fossa ovalis leaving only a small posterior remnant of the footplate which could be easily mobilized by chisel fracture. A polyethylene tube was placed in contact with this mobilized area and articulated with the lenticular process of the incus following a preliminary stapedectomy (see Fig. 8).

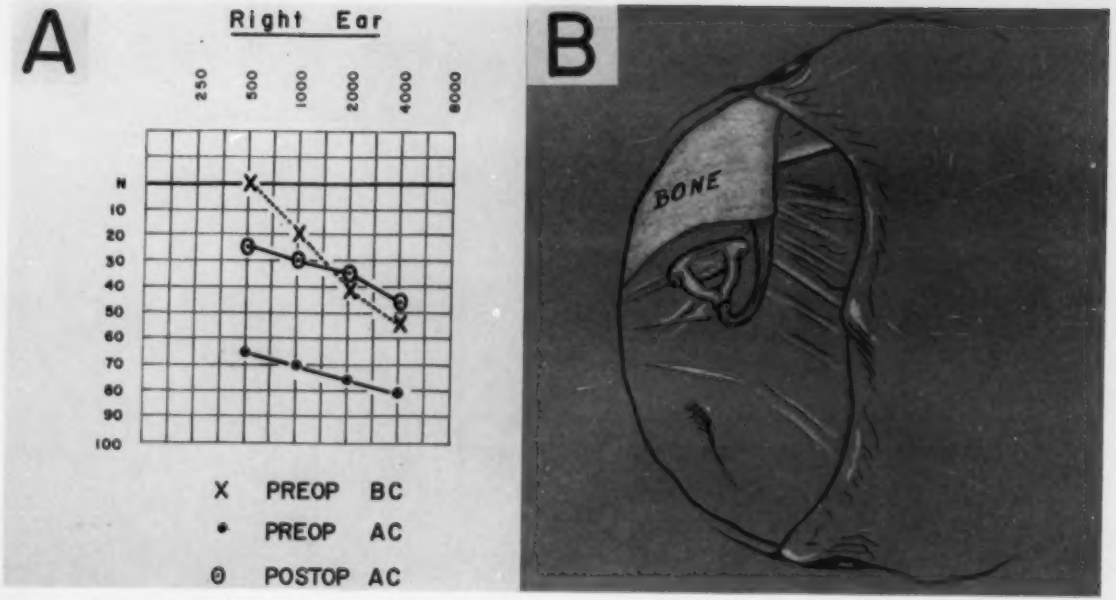


Fig. 7. Incus annulus fusion. A.—Audiogram. B.—Tympanotomy findings. Note bony union between long process of incus and annulus.

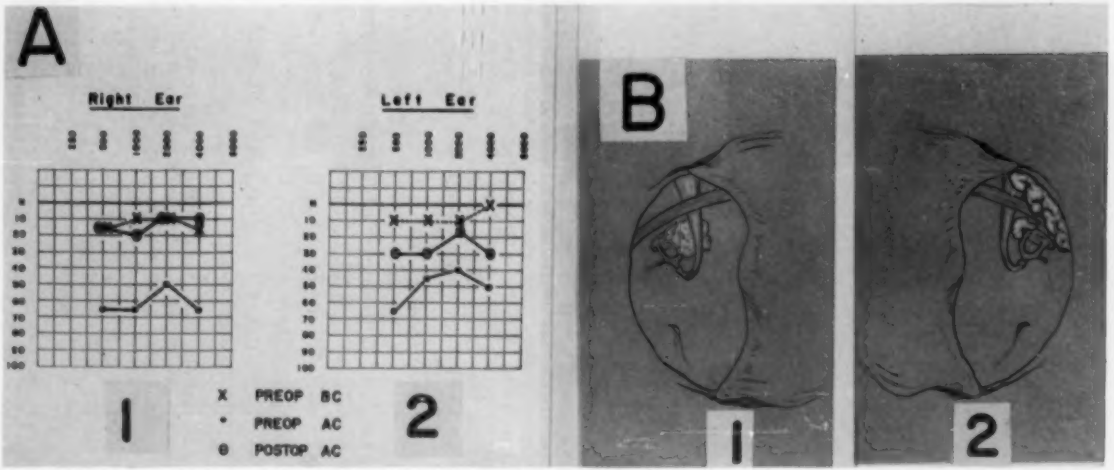


Fig. 8. Co-existent otosclerosis and incudo-malleolar fusion by cholesteatoma. A.—Audiograms. 1. Audiometric findings on otosclerotic right ear; 2. Audiometric findings in ear with combined otosclerosis and incudo-malleolar fusion due to cholesteatoma. B.—Tympanotomy findings. 1. Right tympanotomy findings showing large otosclerotic anterior tumor; 2. Left tympanotomy findings showing anterior otosclerotic tumor and epitympanic cholesteatoma with incudo-malleolar fusion.

D. Incus Atrophy.

In addition to the problem of dislocated incudes and fixed incudes it is possible for a major conduction hypacusis to result from a fibrous atrophic incus which no longer is capable of transmitting acoustic energy because of loss of stiffness. The following is an example of this problem:

Case 9. J.B. This white male, age 30, gave a history of hearing loss in the left ear of 20 years' duration which he dated to a series of mastoidectomies done when he was a child. He stated that he had four mastoidectomies on each side during a period of several years. He has had excellent hearing in the right ear but a very marked loss in the left since that time.

Examination revealed a postauricular healed scar on the right with an intact but slightly scarred right tympanic membrane with a positive Rinné response. On the left, however, in addition to a well healed postauricular scar there was also a perfectly intact and mobile tympanic membrane. The Rinné response was definitely negative. There was evidence of good tubal function bilaterally and there were no significant nasal or nasopharyngeal findings. X-rays revealed operative mastoid defects bilaterally.

The left conductive deficit was accompanied by a lateralization of the Weber to the left side and audiometric findings showed a very definite left conductive hypacusis.

A left exploratory tympanotomy revealed a fibrous incus attached to the capitulum. The stapes was perfectly mobile with evidence of an excellent round window reflex. The fibrous incus was sectioned and the lower remnant removed from the capitulum region. A polyethylene prosthesis was placed between the capitulum of the stapes and the posterior aspect of the tympanic membrane. There was a marked improvement in hearing which has persisted (see Fig. 9).

D. Lenticular Process Necrosis.

One of the most common causes of conductive hypacusis other than otosclerosis is necrosis of the lenticular process of the incus. This is very commonly seen in the course of mastoidectomy and tympanoplasty surgery, but it may also occur behind an intact non-suppurating drum and in such cases may definitely mimic otosclerosis.

Case 10. D.B., a 56-year-old white female, gave a history of recurrent right otorrhea since childhood, and she has been progressively hard-of-hearing for many years, having worn a hearing aid on the left ear for 15 years. There is a history of deafness in a son, but in no other members of the family.

Examination revealed a suppurating right ear with evidence of chronic right mastoiditis.* The left tympanic membrane, however, was intact

*Incidentally, the right ear was operated on separately via a postauricular radical mastoidectomy and a Type III Tympanoplasty with marked improvement in hearing.

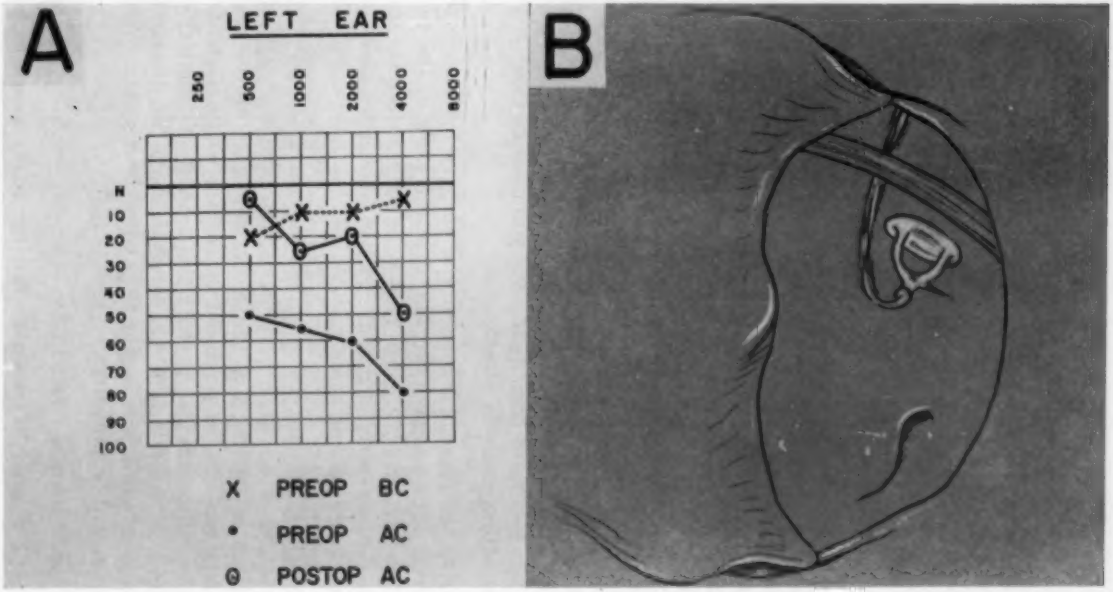


Fig. 9. Incus atrophy. A.—Audiogram. B.—Tympanotomy findings. Note the atrophic non-conductive incus.

and only slightly scarred and mobile. There was excellent left Eustachian tube function. The left Rinné response was negative and there were no significant nasal or nasopharyngeal findings. A bilateral conductive hypacusis was present on audiometry. X-rays revealed a pneumatic right mastoid with attic erosion; the left mastoid was diploic with periantral sclerosis.

A left exploratory tympanotomy was done. The stapes was perfectly mobile; the incus showed evidence of necrosis of the lenticular process. Incudectomy was done by rotation and version. A myringostapediopexy was performed which resulted in a fair improvement in hearing (see Fig. 10).

III. NON-OTOSCLEROTIC DISEASES OF THE STAPES.

The histopathology of otosclerosis strangely received a great deal of attention during the period when the surgery of otosclerosis was at its lowest ebb. The slight flurry of stapes mobilization surgery during the days of Miot,[1] Jack,[2], Blake[3] and their contemporaries died out completely by the second decade of this century. It was during the second and third decades when there was virtually no surgery for otosclerosis (except for the pioneer fenestration research of Gunnar Holmgren[4] and Sourdille[5]), that a great deal was written on otosclerosis pathology. Great controversies were waged in Europe by Otto Mayer,[6] Wittmaack,[7] and Nager,[8] but more heat was generated than light. We still have no clear picture of the pathogenesis of otosclerosis.

During the present renaissance of surgery for otcsclerosis, relatively little research has added to the work of the twenties and thirties. We enter 1960 with the comfortable term, "clinical otosclerosis" but with no real knowledge about this serious and disabling disease.

There are, it must be admitted, certain gross pathologic observations which are accepted quite universally as the manifestations of otosclerosis; however, ankylosis of the stapes footplate can also be produced by certain well defined bone diseases which are not part of the concept of "clinical otosclerosis." These include "Paget's" disease, "brittle bones," tympano-sclerosis, osteo-arthritis, and other diseases. A few examples will be presented.

A. Paget's Disease (Osteitis Deformans).

Paget's disease has been known for many years to be a

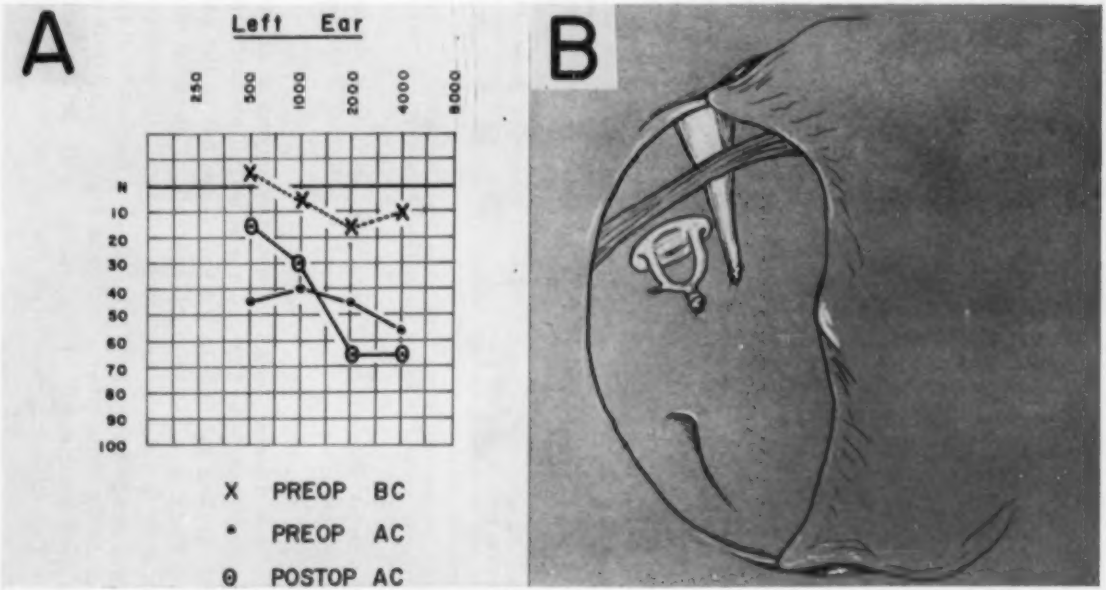


Fig. 10. Lenticular process necrosis. A.—Audiogram. B.—Tympanotomy findings. Note discontinuity between incus and stapes due to lenticular process necrosis.

progressive bone lesion with primary involvement of the skull. Occasional reports have appeared in the literature describing not only ankylosis of the stapes but the occurrence of the large osteomata in ear canals. This disease, also known as osteitis fibrosa, can mimic otosclerosis very closely, as illustrated in this case:

Case 11. J.G., a white male, aged 67, gave a history of a hearing loss in the right ear of only two years' duration. He had no loss in the left ear. There were no other otologic complaints or symptoms. He told us that he had "marble bone disease" with a very strong family history since both his brother and sister have been diagnosed as definite cases of Paget's disease.

Examination revealed non-obstructive osteomata in both external auditory canals. The right tympanic membrane was intact, translucent and mobile. The right Rinné response was negative and the Weber was referred to the right ear. There was good tubal function on politzerization. The left tympanic membrane was intact, translucent and mobile with a positive Rinné response. There were no significant nasal or nasopharyngeal findings. Audiometric examination revealed evidence of a bilateral high frequency neural hypacusis with a superimposed right conductive hypacusis. X-rays of the skull were reported as showing very definite evidence of Paget's disease of the skull.

An exploratory tympanotomy was done with difficulty because of a very narrow and tortuous canal and the presence of osteomata. A good deal of annulus was removed and several bone chips were sent to the laboratory for histologic examination. The footplate was found to be elevated with a very large chalky lesion in the anterior peribasal region. This lesion did not resemble grossly the usual otosclerotic process but was somewhat more brittle and much whiter in color. A peribasal chisel procedure resulted in complete mobilization with a moderate improvement in hearing which has persisted.

Histologic examination of the bone chips from the annulus region showed irregular marble-like mosaic formations characteristic of Paget's disease (see Fig. 11).

B. Osteogenesis Imperfecta (Fragilitas Ossium, Osteopathyrosis, Periosteal Dysplasia, Lobstein's Disease, Eddowes. Disease).

Brittle bone disease, known by many synonyms as shown above, is characterized by the occurrence of multiple fractures with poor healing not only in the long bones but in the calvarium. There is a rather high incidence of so-called otosclerosis with this disease. In most instances, the so-called otosclerosis is a pseudo-otosclerosis, namely a conductive hypacusis caused by some other middle ear lesion. Rarely does one see true otosclerosis in conjunction with brittle bone disease. The following case is an example of this type of problem.

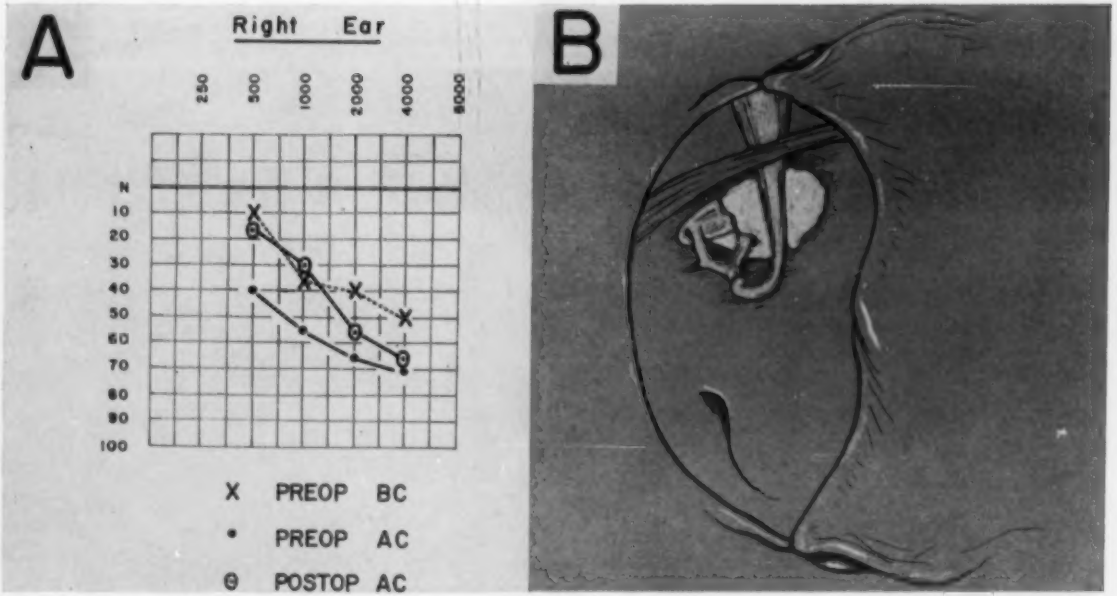


Fig. 11. Paget's disease (osteitis deformans). A.—Audiogram. B.—Tympanotomy findings, showing large flat anterior calcified lesion due to Paget's disease.

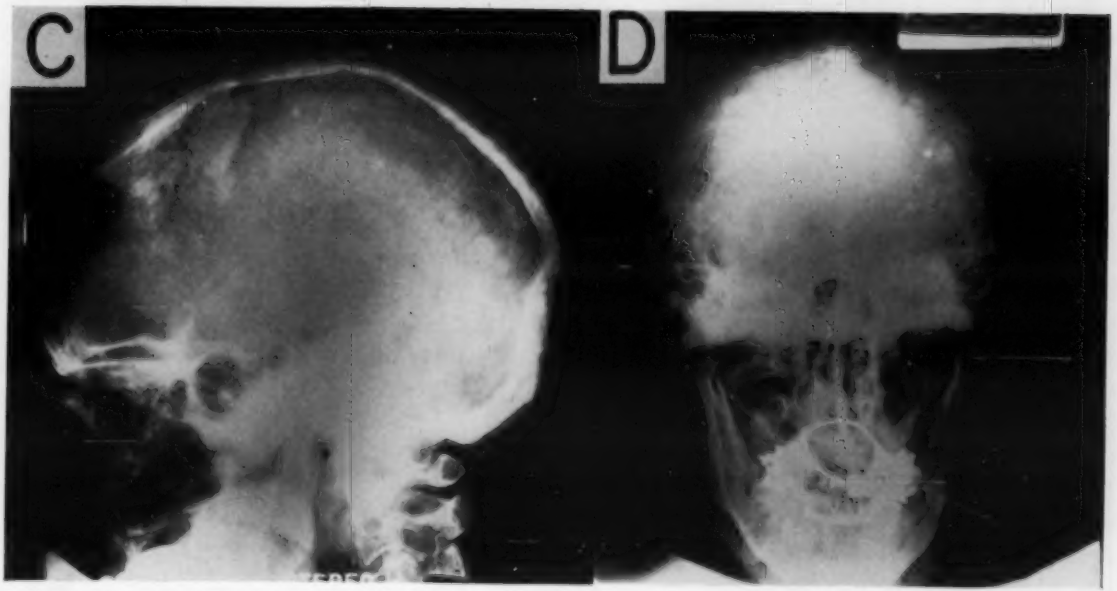


Fig. 11. C.—Lateral view of skull, showing typical marble bone deformation. D.—Antero-posterior view of skull showing typical findings of Paget's disease.

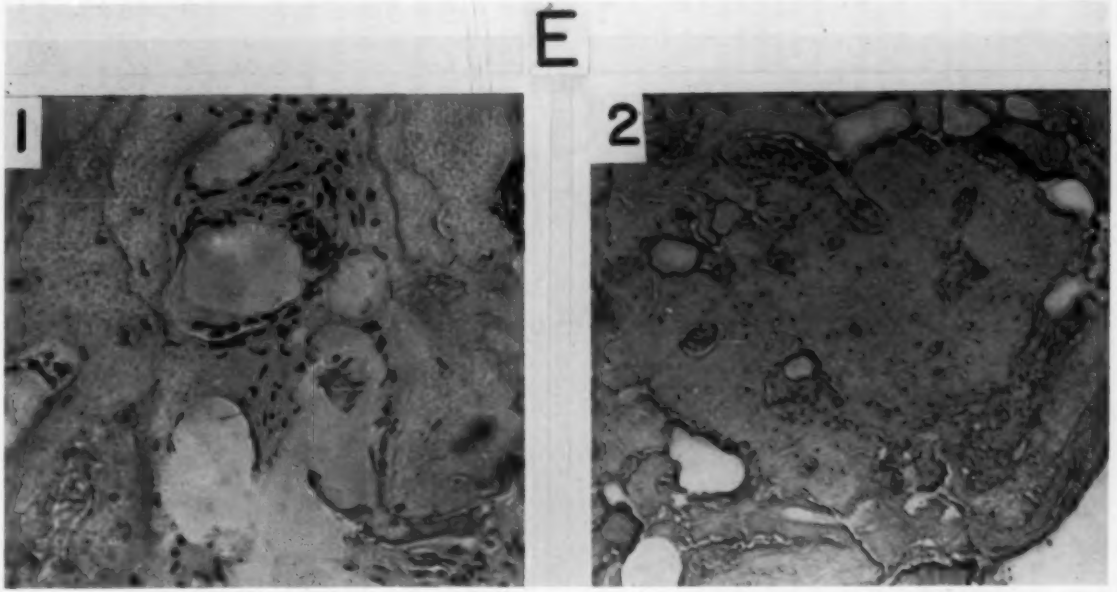


Fig. 11. E.—Histological findings from bone chip taken from annulus in Paget's disease. Note marble-like formation of typical Paget's disease. 1. High power view. 2. Low power view.

Case 12. V.C., a 30-year-old white male, with a known history of fragilitas osseum and many fractures and orthopedic deformities, has known of a bilateral hearing loss for seven years. The loss is greater in the left ear.

Examination revealed that both tympanic membranes were intact, translucent and mobile, and both Rinné responses were equivocal. The Weber was referred to the left ear. There were no significant findings in the nose and throat except for mild chronic tonsillitis. Both Eustachian tubes were patent on politzerization. X-rays of the mastoids revealed evidence of extensively pneumatized temporal bones with very thin skull markings and obvious rarefaction throughout the skull.

Audiometric studies revealed a bilateral conductive deficit with greater involvement in the left ear. Peculiarly enough, however, there was a greater loss in the higher frequencies in both ears by air conduction. Bone conduction was extraordinarily good.

An exploratory tympanotomy revealed a perfectly mobile stapes footplate. The incus was normal and the incudostapedial joint was normal. Both crura, however, literally "hung in mid air" since they were not attached to the footplate at all. They were attached to the promontory by a few thin strands of fibrous tissue. There was no stapedial vestibular continuity. There was a small stump of anterior crus still attached to the anterior portion of the footplate. Following removal of the pathological stapes remnant, a polyethylene prosthesis was placed on this anterior crural stump and articulated with the lenticular process of the incus with a marked improvement in hearing (see Fig. 12).

C. Tympano-sclerosis.

Tympano-sclerosis is probably a variant of chronic otitis media in which onion-like scales of keratin grow throughout the tympanic cavity. The keratinization and hyalinization process seems to involve mucosa and periosteum. The lesion may invade the labyrinthine capsule and may destroy the stapedial crura and footplate. Tympano-sclerotic plaques can occur anywhere in the middle ear and may occur in the mastoid antrum although it is rather unusual to find tympanosclerosis in any of the periantral cells. It is possible for tympano-sclerosis to occur silently with an intact drum producing a marked conductive hypacusis and thus mimic otosclerosis.

Case 13. M.S., a 43-year-old white female, gives a history of progressive hearing loss in the right ear of 15 years' duration. She does recall having some otorrhea and earaches in childhood.

The right tympanic membrane was mobile, and the Eustachian tube was open on politzerization. The Rinné response was negative and the Weber test was referred to the right ear. There were no significant nasal or nasopharyngeal findings. X-rays revealed sclerotic mastoids bilaterally. There was a marked right conductive hypacusis.

Right exploratory tympanotomy revealed evidence of marked stapedial tympano-sclerosis with stapedial ankylosis produced by the lesion. Onion-

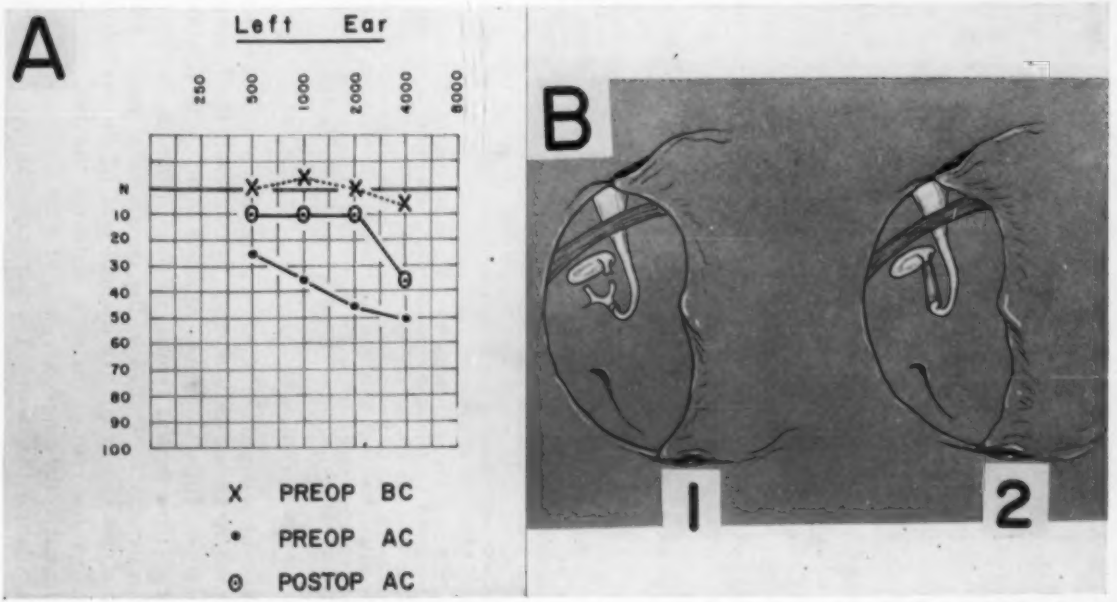


Fig. 12. Osteogenesis imperfecta (fragilitas osseum). A.—Audiogram. B.—Tympanotomy findings. 1. Note stapes crura discontinuous with footplate. 2. Note polyethylene prosthesis between lenticular process of incus and aberrant remnant of anterior crus.

like plaques of tympano-sclerotic keratin fixed the crura to the surrounding tympano-sclerotic promontory and perifacial lesions. It was impossible to remove all of these plaques and it was impossible to mobilize the stapes crura by any method. Accordingly, the crura were removed, following which the tympano-sclerotic plaques were extensively dissected away from the labyrinthine capsule in its entire medial tympanic portion. A polyethylene prosthesis was placed between the lenticular process of the incus and the footplate which was not fixed. There was a moderate improvement in hearing immediately (see Fig. 13).

D. Footplate Arthritis (Osteo-arthritis of the Stapedial Vestibular Articulation).

Among the lesions following chronic otitis media there may be an actual arthritic degeneration of the peristapedial annular ligament. This frequently will accompany a tympanic fibrosis but will actually mimic otosclerosis in that the stapedial footplate itself will be fixed by an ossification of the annular ligament. In these cases there is no visible typical otosclerotic tumor but the fixation is circumferential and quite diffuse.

Case 14. M.Z., a 62-year-old white female, has been aware of a bilateral hearing loss of five years' duration. She has had recurrent otitis media during the past few years, and has a long history of chronic sinusitis and nasal allergy. Examination revealed that both tympanic membranes were intact, slightly scarred but mobile. Both tubes showed evidence of normal function on politzerization. Both Rinné responses were negative. X-rays of the mastoids showed well pneumatized structures bilaterally, but there was some clouding of the cells on the left side. There was no evidence of periantral sclerosis.

A left exploratory tympanotomy revealed a slight amount of tympanic fibrosis which did not immobilize the ossicular chain as far as the incus and malleus were concerned. The stapes, however, was completely fixed by a peristapedial calcification. There was no visible otosclerotic tumor. Circumferential chisel cuts produced an immediate mobilization of the stapedial footplate with a marked gain in hearing. This gain in hearing dropped somewhat during the postoperative period (see Fig. 14).

E. Peristapedial Tent.

Chronic intratympanic fibrosis is a frequent sequel of either suppurative or serous otitis media. In most cases the fibrosis is diffuse and fills the entire tympanic cavity with fixation of most of the ossicular chain. In some instances, however, this fibrosis may be limited to the peristapedial region and will thus look somewhat like a small tent of fibrous tissue surrounding the crura. In such instances the rest of the tympanic cavity is completely free of scar tissue and there is no fixation of the incus. The peristapedial tent can very

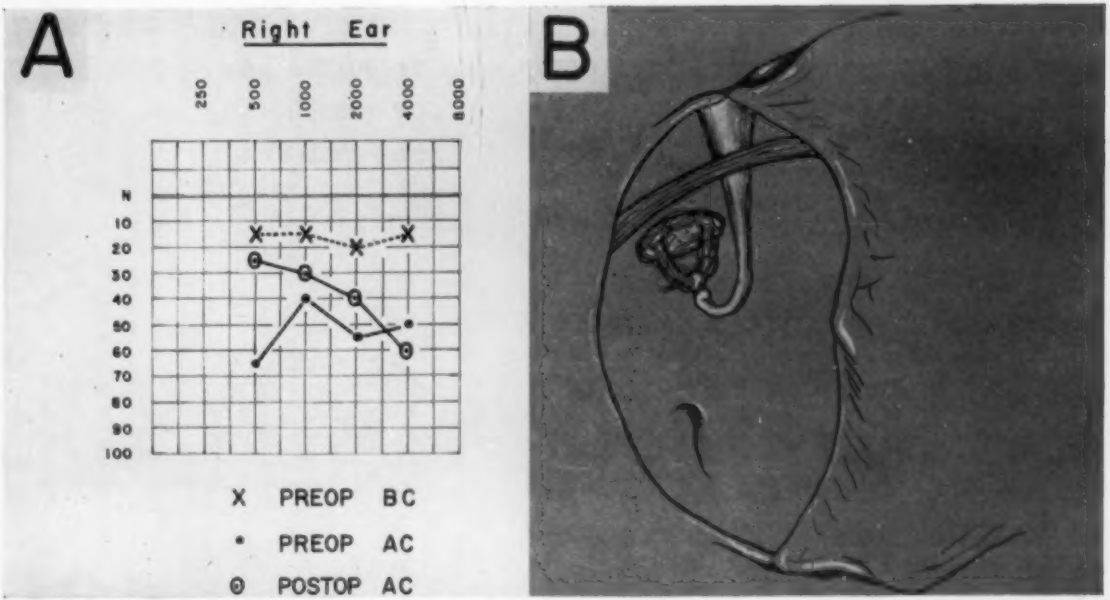


Fig. 13. Tympano-sclerosis. A.—Audiogram. B.—Tympanotomy findings. Note tympano-sclerotic lesion confined to crura and footplate of stapes.

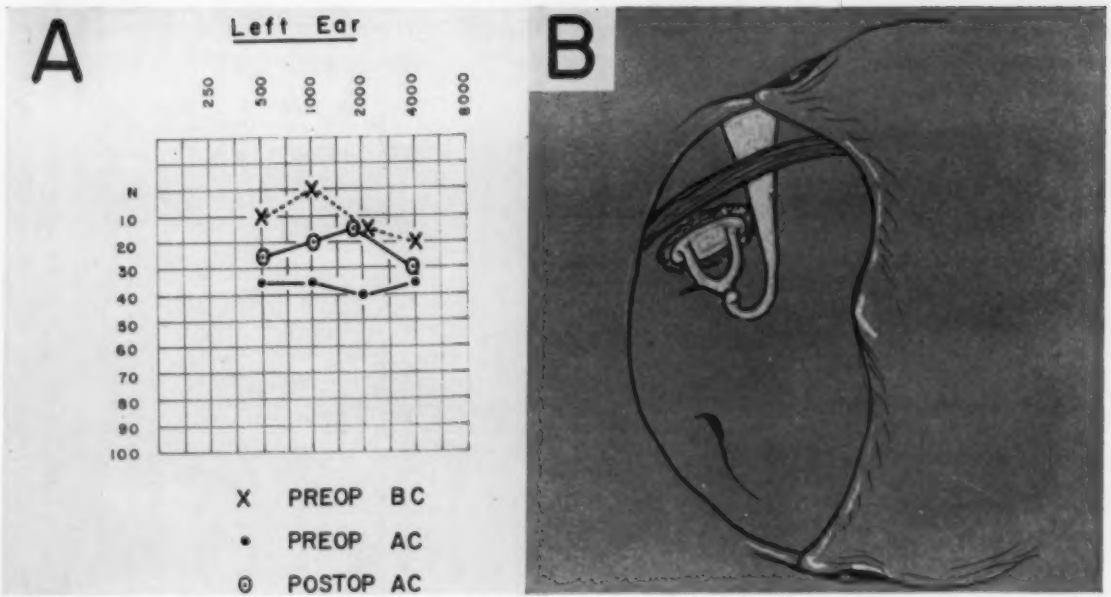


Fig. 14. Footplate arthritis. A.—Audiogram. B.—Tympanotomy findings. Note circumferential lesion involving entire annular ligament without otosclerotic tumor.

effectively immobilize the stapes and thus simulate otosclerosis.

Case 15. E.S., a 48-year-old white female, gave the history of progressive right hearing loss of eight years' duration. There was no familial history of deafness. She does recall having had some earaches in childhood.

Examination revealed that both tympanic membranes were intact, translucent and mobile. There was no scarring and there was no fluid in either ear. Both tubes were normal on politzerization. The right Rinné response was negative and the left Rinné response was negative. The Weber test was referred to the right ear. Audiometric studies revealed a fairly marked right conductive hypacusis. X-rays revealed bilaterally well pneumatized mastoids, with no evidence of periantral disease or sclerosis. A presumptive diagnosis of right otosclerosis was made.

An exploratory tympanotomy revealed a perfectly normal middle ear with mobile incus. The stapes, however, was completely enveloped by a fibrous tent and there was no round window reflex on transincudal palpation. Following dissection of the very tight bands of fibrous tissue away from the crura, it was found that the footplate was intact and mobile. This was followed by a marked improvement in hearing on surgical audiometry, with an excellent round window reflex on transincudal palpation.

Her hearing gain has persisted (see Fig. 15).

F. Congenital Fixation.

During the past few years several authors (H. House, W. House and V. Hildyard[9]) have described "congenital fixation of the stapes."

Among the clinical features ascribed to the congenital cases were lack of progression, flat curves, and fairly typical diffuse calcified changes in the total footplate, without a typical otosclerotic tumor.

Among the many congenital anomalies in our collection, we have seen many footplates which were fixed and which looked entirely different from the usual picture of clinical otosclerosis; however, in all of our cases, there were other anomalous conditions in the middle ear and we have not encountered any case in which there was a simple footplate fixation of the type described without other changes either in the windows, incus, stapedial tendon, or otic capsule. Accordingly, it seems that the reported entity of primary congenital footplate fixation is worthy of further study before it is given a definitive position among the group of pseudo-otosclerotics.

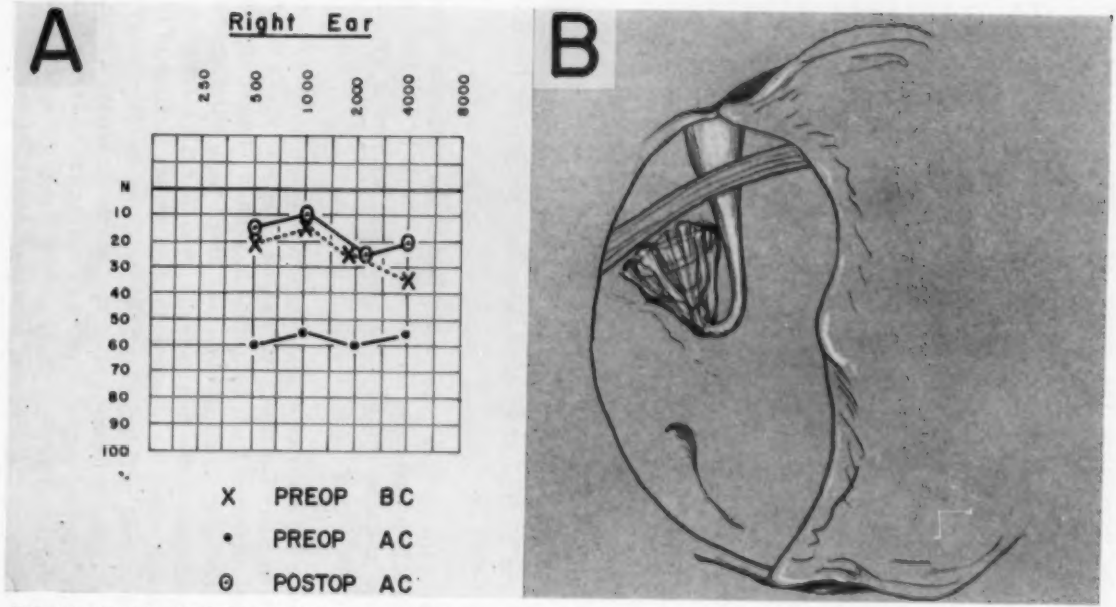


Fig. 15. Peristapedial fibrous tent. A.—Audiogram. B.—Tympanotomy findings. Note fibrous tent enclosing stapes and producing stapedial fixation.

IV. ANOMALIES OF OSSICLES AND WINDOWS.

Our cases include a number of tympanic anomalies producing conductive defects indistinguishable preoperatively from otosclerosis. No attempts will be made in this paper to delineate the various types of anomalies. Two examples will suffice for this category.

Case 16. R.V. This 28-year-old white female has known of a hearing loss in the right ear since childhood. The left ear has been normal.

Examination revealed an intact, translucent and mobile right tympanic membrane with a negative Rinné response and evidence of good tubal function on politzerization. The Weber test was lateralized to the right ear. The left ear was normal. There were no significant nasal or nasopharyngeal findings. X-rays of the mastoids revealed extensively pneumatized normal temporal bones, bilaterally symmetrical and equal.

Audiometric studies revealed a typical right conductive deficit and a presumptive diagnosis of right otosclerosis was made, although the possibility of a congenital anomaly was considered.

Exploratory tympanotomy on the right side revealed no evidence of an incus. The stapes was represented by a posterior crus and capitulum only, to which was attached a rather small stapedial tendon below the neck region, and a remnant of a lenticular process as a tiny aberrant ossicle on top of the capitulum which was otherwise normal. The anterior aspect of the neck was absent and there was only a small stump of anterior crus on the footplate. The footplate was otherwise completely normal and mobile. After de-epithelialization of the mucosal aspect of the tympanic membrane, the entire posterior half of the omega flap was invaginated into the middle ear to contact the aberrant lenticular process on the aberrant posterior crus. The denuded posterior canal wall skin was covered by a split thickness skin graft taken from the postauricular region. There was a marked improvement in hearing subjectively on the operating table, and this hearing improvement has been maintained through this transtympanic myringostapediopexy performed only through the single posterior crus see Fig. 16).

It is possible for a congenital anomaly to exist in one ear of a patient who has otosclerosis in the other ear. This striking coincidence is exemplified in the following case:

Case 17. L.T. This white male was first examined in 1957 at the age of 63, with a history of bilateral deafness since 1919 following the flu epidemic. There had been a progressive increase in the hearing loss, however, in recent years. He had been wearing a hearing aid in the left ear for many years.

Examination revealed that both tympanic membranes were intact and translucent and mobile. Both Eustachian tubes were patent on politzerization and both Rinné responses were negative.

Audiometric examination revealed a very marked bilateral conductive deficit with a significant neural hypacusis as well. He was considered to have evidence of bilateral far advanced otosclerosis with neural degeneration, and was told that he was only a very poor candidate for mobilization surgery.

A right exploratory tympanotomy revealed a very extensive antero-

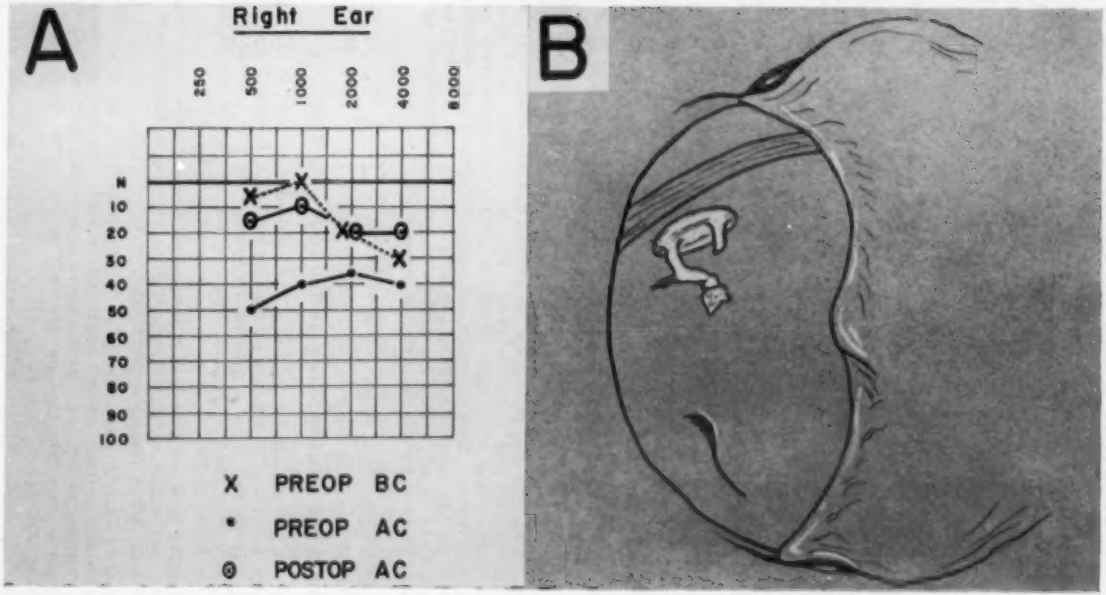


Fig.16. Congenital anomaly. A.—Audiogram. B.—Tympanotomy findings. Note tympanotomy opening revealed no incus. There was an abnormal stapes represented by a posterior crus with a lenticular process and a short stub of an anterior crus.

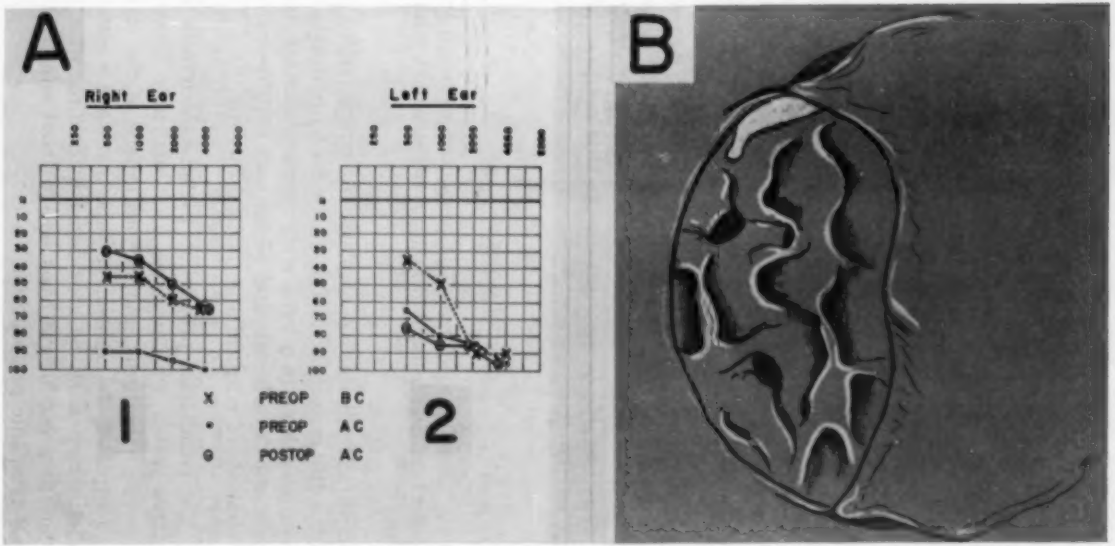


Fig. 17. Congenital anomaly. A.—Audiogram. 1. Right ear shows gain in hearing following conventional stapes mobilization; 2. Left ear shows no change in hearing in congenital anomaly. B.—Tympanotomy revealed congenital anomaly left ear.

superior otosclerotic lesion, which was easily mobilized by peribasal chisel techniques with a marked improvement in hearing (see Fig. 17).

In view of the very encouraging result in the right ear, it was subsequently decided to explore the left ear as well.

A left exploratory tympanotomy revealed no recognizable incus nor were there any recognizable vestiges of stapes, oval window or round window. The middle ear contained a very thick mucous membrane and the labyrinthine capsule was represented by a scalloped bone with anomalously placed niches and depressions here and there. Several exostoses could be seen which might have been interpreted as ossicular anlages but no definite anatomical landmarks could be made out anywhere. The middle ear was closed without further attempt at manipulation.

It is most difficult to explain this. Retrospective history questioning yielded no further significant information. The patient was reasonably certain at first that the hearing loss had been bilaterally progressive, but upon a good deal of reflection he admitted that the progressive aspect was primarily in the right ear and was of the opinion that the left ear had been severely deafened since childhood; however, he was not certain of this. Thus we can see that a patient with a bilateral conductive deafness with a history of progression with demonstrable otosclerosis on one side need not have otosclerosis on the other side.

CONCLUSIONS.

The term, "pseudo-otosclerosis" is presented as a semantic diagnostic tool in differential diagnosis of so-called clinical otosclerosis.

The widespread advocacy of exploratory tympanotomy for the patient with conductive deafness is indeed justifiable but the clinician must keep in mind a wide range of clinical states which may mimic otosclerosis and which may require entirely different methods of surgical and medical therapy.

Among the conditions producing pseudo-otosclerosis are various states which may produce total ossicular fixation, various lesions of the incus, and various lesions of the stapes crura and footplate. In addition to this, there are a number of anomalies which must be considered in dealing with the patient who has a conductive hypacusis without suppuration and without tympanic perforation.

SUMMARY.

The subject of differential diagnosis of clinical otosclerosis is introduced as a diagnostic concept entitled, "pseudo-otosclerosis." A number of varieties of tympanic lesions capable of producing otosclerosis-like states are described and exemplified by case reports and audiograms.

Among the pseudo-otosclerotic lesions are fibrotic states of the tympanic cavity, tympano-sclerosis, Paget's disease, (osteitis deformans), fragilitas ossium (osteogenesis imperfecta), and numerous other lesions.

The otologist planning exploratory tympanotomy is urged to consider carefully all of these different diagnostic possibilities in addition to the classical concept of clinical otosclerosis.

BIBLIOGRAPHY.

1. Miot, C.: De la Mobilisation de l'Etrier. *Rev. Laryngol.*, 10:59, 82, 113, 145 and 200, 1890.

2. Jack, F. L.: Remarkable Improvement in Hearing by Removal of Stapes. *Trans. Amer. Otol. Soc.*, 5:284, 1891-1892.

3. Blake, C. J.: Operation for Removal of the Stapes. *Boston Med. and Surg. Jour.*, 127:469, 1892.

4. Holmgren, G.: Some Experiences in Surgery of Otosclerosis. *Acta Oto-Laryngol.*, Suppl. 26:1-223, 1938.

5. Sourdille, M.: "Nouvelles Techniques Chirurgicals Pour le Traitment des Surdites de Conduction ou Otosclerosis." Presentatione Soc. d'Otologie des Hospitaux de Parix, Dec. 16, 1929. Academie de Medicine, Paris, Dec., 1929.

6. Mayer, Otto: "Untersucheungen Uber die Otosklerose." Alfred Holder, Wien, 1917.

7. Wittmaack, K.: "Die Otosklerose auf Grund Eigener Forschungen." Gustav Fischer, Jena, 1919.

8. Nager, F. R., and Meyer, Max: Die Erkrankungen des Knochensystems. S. Karger, Berlin, 1932.

9. House, H.; House, W., and Hildyard, V.: Congenital Stapes Footplate Fixation. *Trans. Amer. Laryngol., Rhinol. and Otol. Soc., Inc.*, 139-152, 1958.

A COMPARATIVE IN VITRO EVALUATION OF VARIOUS ANTIBIOTICS.*†‡

DAVID A. DOLOWITZ, M.D.,
LOWELL A. WOODBURY, Ph.D.,
(By Invitation),
and
RALPH KNIGHT, Ph.D.,
(By Invitation),
Salt Lake City, Utah.

INTRODUCTION.

The natural variability of bacterial responses to antibiotics and chemotherapeutic agents causes such differences in repeated sensitivity tests of a given organism as to raise doubt concerning the specific treatment for any given infection. The textbooks, the technical literature and the advertisements of the pharmaceutical houses are often at odds with one another in their recommendations. Some of the discrepancies lie in the various methods of testing,[1,2,3] some reflect sampling variations and some sundry factors as geography, origin of culture, etc. In making a decision only the determinable probabilities can be used, and the physician must rely on his clinical acumen and the report from the local laboratory as to the sensitivity of the patient's specific organism to antibiotics.

The average clinical laboratory, chronically overloaded and undestaffed, has neither time, facilities, nor finances to run the more accurate tube dilution sensitivities for study of the myriads of cultures and their antibiotic sensitivities which are submitted for testing each year; hence, in the run of the mill cases, the disc method of testing must be used. While

*Read at the meeting of the Western Section, American Laryngological, Rhinological and Otological Society, Inc., Denver, Colo., Jan. 22, 1960.

†From the Departments of Surgery and Anatomy, University of Utah, the Holy Cross Hospital and the Memorial Medical Center, Salt Lake City, Utah.

‡This work was made possible by grants from the Richards Medical Foundation, Salt Lake City, Utah, and the Darwin Laboratories, Los Angeles, Calif.

Editor's Note: This manuscript received in The Laryngoscope Office and accepted for publication Feb. 25, 1960.

the faults of this method are well known,[1,2,3] it still constitutes a satisfactory rough quantitative test for bacterial sensitivities.[4] Practically, these data constitute the working material from which the clinician must make his decision.

This situation prompted a study of a series of the routine sensitivity tests. An analysis and summarization were made to discover the relative percentages of organisms, their relative sensitivity to antibiotics, the effects of mixtures of the organisms and the possible relation of antibiotics to each other and to the organisms.

In a sense this report is a demonstration of the wealth of material that can be gleaned from certain types of clinical data and an exposition of certain methods of analysis which have been modified and adapted to use with bacterial-antibiotic studies.

Because these data are the material which the clinician must use in making his decision, no attempt has been made to check the accuracy of the laboratories or to modify or correct the reports in any way. Rather the data are taken as received by the physician and studied.

MATERIALS AND METHODS.

Source of Data: Routine antibiotic sensitivity test reports were abstracted serially from the laboratory day books. Reports were obtained from two large medical centers in Salt Lake City with the data from each being roughly equal in numbers. The institutions were the Memorial Medical Center and the Holy Cross Hospital, and we are indebted to these institutions for permission to use their data.

PERIOD OF STUDY.

Two groups of data were taken and used for somewhat different purposes. The first group consisting of approximately 1,000 reports of cultures was obtained from all complete reports of sensitivity tests over the period from July, 1958, to about April, 1959. This group was used primarily to obtain relative abundances of the various organisms and mix-

tures. The second group consisted of a sampling of the records from July, 1956, to July, 1958. The sampling varied with the organism and was used to obtain larger numbers of the rarer organisms. All complete reports were used from July, 1956, to April, 1959, for the following organisms: Bacillus subtilis; Escherichia coli; Klebsiella aerogenes; Neisseria catarrhalis; Pseudomonas aeruginosa; Proteus vulgaris; Staphylococcus albus and aureus; Streptococcus viridans; Beta hemolytic streptococci; non-anhemolytic and anaerobic streptococci.

For Staphylococcus aureus and Staphylococcus albus a total sample was taken for the period of June to December, 1956, and July, 1957, through April, 1959. A separate group of Staphylococcus aureus data was collected from examination of the Holy Cross operating room staff.

The various groups were treated in different ways as will be developed below, but all were combined together to obtain the percentage responses of the various species of bacteria to the different antibiotics.

TREATMENT OF DATA.

From each report the chart number, the location from which the culture was taken, the organisms found and their sensitivities were recorded. These data were abstracted and coded for ease in tabulation. The larger tabulations were performed on IBM equipment, the smaller ones were done by hand.

Relative Abundance of Organisms.

Table I shows the relative abundance of the various species of bacteria encountered in 1,000 consecutive cultures. The Table is subdivided by the number of species of organisms found in the various cultures. The cultures varied in this respect from a pure culture of one organism up to a maximum of four.

The total number of any given species was counted regardless of the number of types or organisms in the culture. In the 1,000 cultures studied a total of 1,447 strains of the differ-

ent species was found, giving an average of 1.45 species per culture.

An interesting observation is that the number of gram negative organisms found in cultures was relatively high. Escherichia coli, Klebsiella aerogenes, Neisseria catarrhalis, Pseudomonas aeruginosa and Proteus vulgaris accounted for

TABLE I.

Number of Species in 1,000 Serial Cultures.

Species	1	2	3	4	Number of Strains	Relative Abundance Per Cent
	Per Cent of Species in Given Mixture					
Alcal. Fecalis	50	50	0	0	6	0.41
B. Subtilis	23	62	15	0	13	.90
Candida Albicans, etc.	14	57	29	0	7	.48
Diplococcus Pneumoniae	29	71	0	0	7	.48
Diphtheroids	20	60	20	0	5	.34
E. Coli	77	18	5	0	104	7.19
Klebsiella	69	26	5	0	140	9.68
Neisseria	0	43	46	11	37	2.56
Pseudomonas	72	23	5	0	75	5.18
Proteus Vulgaris	63	31	6	0	32	2.21
Salmonella Paratyphii	100	0	0	0	5	.34
Shigella Dysent.		0	0	0	1	.07
St. Albus	39	41	18	2	304	21.01
St. Aureus	62	28	9	1	278	19.21
Strep. Viridans	25	46	26	3	205	14.18
Strep. B. Hemo.	16	56	26	2	114	7.88
Strep. Anhemo	16	57	26	1	70	4.84
Strep. Anaerobic	100	0	0	0	3	.21
Hemoph. Influenzae	0	68	26	5	19	1.31
Entero. Cocci	0	79	21	0	19	1.31
Miscellaneous	33	0	67	0	3	.21
						100.00
Number	641	552	234	20	1,447	
Relative Abundance Per Cent	44.3	38.1	16.2	1.4		100.00

26.82 per cent of the organisms found. The combined staphylococcus and streptococcus forms had the highest relative abundance of 67.33 per cent but the gram negative group was surprisingly numerous.

An inspection of the percentage of strains of a given species found in pure cultures and in mixed cultures shows extreme variation from species to species. For example, over 60 per cent of the strains of Escherichia coli, Klebsiella aerogenes,

Pseudomonas aeruginosa, Proteus vulgaris and Staphylococcus aureus were found in pure cultures.* On the other hand no strains of Neisseria catarrhalis, Hemophilus influenza or enterococci were found in pure culture. Particularly noteworthy is the fact that Staphylcoccus albus was found in pure cultures only 39 per cent of the time as contrasted with Staphylococcus aureus which was found 62 per cent of the time. Pure cultures of streptococci were relatively rare.

NUMBER OF POSSIBLE MIXTURES.

These interspecies differences in the relative numbers found in pure and mixed cultures suggested an investigation of the species comprising the mixtures. The 12 most common clearly defined species were selected for the investigation. The maximum number of species recorded in a given culture was four. With 12 species and a random distribution the maximum possible numbers of mixtures and the numbers observed were:

Number of Species in Culture	Number of Possible Mixtures	Number of Mixtures Cultured
1	12	10
2	66	45
3	220	32
4	495	5
Total	793	92

A much smaller number of mixtures of the different species is observed than would be expected on the basis of a random distribution. By a random distribution we mean that only factors of a chance nature cause the mixtures; factors of antagonism, commensalism, symbiosis and different environmental requirements are not considered. The relatively small number of observed mixtures as compared with the possible mixtures would suggest that some or all of the above and possibly other factors are at work.

To check this possibility a coefficient of association (Ken-

*Species with less than ten strains recorded are not considered in this discussion.

dall,[5] 1950, p. 30) was computed for each possible pair of organisms, and the results are given in Table II.

The coefficient of associations, commonly designated by the symbol "Q" is a measure of the degree of association. A value of a +1.0 would indicate that the two species were always found together, never apart, which might mean a symbiosis or commensalism. A value of a –1.0 would mean that the two species were never found together which could indicate a profound antagonism. A value of 0.0 would indicate that the species were found together about as often as would be expected on the basis of pure chance.

It must be realized that these values were derived from cultures grown on agar plates and that one culture might overgrow another, or that antagonisms or symbioses not present in tissue might be present on the plates in the laboratory; nevertheless, the derived values suggest some interesting possibilities.

An inspection of the Table shows that the majority of the values is negative, indicating that an effective antagonism exists between the various pairs of species. This is not too surprising; however, the high negative values for some of the common mixtures such as Staphylococcus albus, Staphylococcus aureus (–0.62) and Staphylococcus aureus, Streptococcus viridans (–0.49) are interesting.

The positive associations are of the most interest because they indicate that the two species are found together more often than would be expected by chance.

Neisseria catarrhalis, Streptococcus viridans and Hemophilus influenzae showed a tendency towards having the most positive associations. Particularly noteworthy are the following:

Neisseria catarrhalis - Streptococcus viridans	+0.82
Neisseria catarrhalis - Staphylococcus albus	+0.53
Staphylococcus aureus - Hemophilus influenzae	+0.57
Sterptococcus viridans - Beta Hemolytic Streptococcus	+0.48

It is interesting to note that Hemophilus influenzae and

TABLE II.

Association Between Different Species.

	6 E. Coli	7 Klebsiella	8 Neisseria	9 Pseudomon.	10 Proteus	16 St. Albus	18 St. Aureus	20 Strep. Virid.	21 Strep. B. Hemo.	22 Strep. Anhemo.	26 Hemoph. Influenzae
B. Subtilis	−1.00	−1.00	−1.00	−1.00	+0.44	+0.68	−0.36	1.00	−1.00	−0.05	−1.00
E. Coli		−0.48	−1.00	−0.80	−0.57	−0.58	−0.92	0.76	−1.00	−0.46	−1.00
Klebsiella			−1.00	−0.51	−0.07	−0.72	−0.85	−0.51	−0.66	−0.85	−1.00
Neisseria				−1.00	−1.00	+0.53	−0.72	+0.82	0.10	−0.47	+0.52
Pseudomon.					+0.29	0.60	−0.82	−0.74	−1.00	−0.71	−1.00
Proteus						0.74	−1.00	−1.00	−1.00	−0.41	−1.00
St. Albus							−0.62	+0.20	−0.04	+0.26	0.03
St. Aureus								−0.49	−0.29	0.02	+0.57
Strep. Viridans									+0.48	−0.17	+0.29
Strep. B. Hemo.										−0.17	−0.68
Strep. Anhemo.											−1.00
Hemoph. Influenzae											

Neisseria catarrhalis were not observed in pure culture and that Streptococcus viridans was found in pure culture only 25 per cent of the time.

In our clinical experience Proteus and Pseudomonas are frequently found together in chronic mastoid infections; Staphylococcus aureus sinusitis often follows Hemophilus influenzae infection of the upper respiratory tract and Streptococcus viridans infections often are left as the residue of a Beta Hemolytic streptococcus infection. These are especially interesting in view of the positive association between them *in vitro* as illustrated in Table II, as it may indicate a conversion from a relative saprophyte to a parasite when they occur together.

RESULTS OF SENSITIVITY TESTS AGAINST PURE CULTURES.

The results of the sensitivity tests of the antibiotics and chemotherapeutics are given for the various species of bacteria in Table III. The results are expressed in percentage of strains inhibited or killed by each antibiotic.

An inspection of the response of each species of bacteria to the various antibiotics shows similarity between certain groups of the antibiotics. There is naturally some variation, but the over-all pattern is clear.

By grouping together those antibiotics having similar responses, a profile of per cent response versus species of bacteria can be constructed. The profiles so obtained are shown in Fig. 1.

A total of six qualitatively distinct groups was found as follows:

Group I consists of Penicillin, Erythromycin, Bacitracin, Novobiocin and tentatively Oleandomycin. The last is only tentative because of insufficient data. This group has little effect on most gram negative bacteria but acts rather successfully against the gram positive group.

Group II consists of the Tetracyclines and Nitrofurantoins. While drug house advertising leaves the impression of varying

TABLE III-A.

Summary of Results of Tests of Pure Cultures of Bacteria Against Various Antibiotics.
Per Cent of Strains Sensitive to Gram Negative Organisms.

Antibiotics and Bacteriostatics	Bacillus Subtilis	Escherichia Coli	Klebsiella Aerogenes	Pseudomonas Aeruginosa	Proteus Vulgaris
Penicillin	35	1	5	1	23
Erythromycin	65	2	6	1	3
Tetracycline	75	43 (383)	38	7	13
Oxytetracycline	82 (11)	43 (281)	34 (101)	7 (118)	12 (60)
Chlortetracycline	82 (11)	43 (281)	33 (101)	7 (118)	10 (60)
Chloramphenicol	85	91	69	42	82
Streptomycin	70	56	42	59	68
Bacitracin	25	1	8	4	4
Neomycin	55	56	72	32	56
Polymixin B		54 (61)	28 (97)	54 (46)	0 (15)
Novobiocin	85 (13)	4 (341)	5	3 (160)	8 (110)
Nitrofurantoin	40 (10)	65 (269)	34 (105)	3 (119)	18 (82)
Oleandomycin		1 (82)	6 (100)	2 (46)	0 (14)
Cyclamycin					
Gantrisin Sulfisoxazol	25	28	28	3	12
Elkosin Sulfaclimetine	18 (17)	22 (300)		0 (117)	8 (107)
Triple Sulfa	12 (17)	21 (300)		9 (117)	10 (107)
Sulfadiazine	6 (17)	22 (300)		18 (117)	6 (107)
Sulfamerazine	12 (17)	26 (300)		2 (117)	9 (107)
Thiosulfyl	12 (17)	15 (300)		0 (117)	5 (107)
Sulfathiazole		15 (300)			8 (107)
Number of Strains Tested	20	384	109	174	117

Figures in parentheses indicate the numbers of strains upon which the percentage was based when the number of strains differs from the total given at the bottom of page.

TABLE III-B.

Summary of Results of Tests of Pure Cultures of Bacteria Against Various Antibiotics.
Per Cent of Strains Sensitive to Gram Positive Organisms.

Antibiotics and Bacteriostatics	Staphylococcus Albus	Staphylococcus Aureus	Streptococcus Viridans	Streptococcus Beta Hemolytic	Streptococcus Anhemolytic	Streptococcus Anaerobic
Penicillin	67	45	87	92	86	94
Erythromycin	81	75	83	85	84	90
Tetracycline	40	41	78	58	77	87
Oxytetracycline	38 (166)	39 (209)	76 (58)	65 (23)	76 (62)	83 (24)
Chlortetracycline	39 (166)	38 (209)	79 (58)	61 (23)	76 (62)	88 (24)
Chloramphenicol	86	86	96	95	93	100
Streptomycin	53	45	44	22	49	68
Bacitracin	85	82	78	85	88	87
Neomycin	64	66	9	20	23	16
Polymixin B	2 (92)	5 (174)	2 (46)	6 (17)	0 (7)	
Novobiocin	85 (221)	68 (243)	73 (74)	61 (38)	72 (82)	71 (28)
Nitrofurantoin	83 (76)	79 (47)	28 (74)	95 (18)	69 (48)	65 (17)
Oleandomycin	73 (92)	51 (170)	36 (72)	88 (17)	57 (7)	
Cyclamycin	83 (24)	92 (25)	86 (7)	70 (10)		
Gantrisin Sulfisoxazol	28	16	8	12	0	3
Elkosin Sulfaclimetine	12 (125)	18 (82)	5 (19)	2	2 (80)	3
Triple Sulfa	12 (125)	13 (82)	5 (19)	2	4 (80)	3
Sulfadiazine	10 (125)	13 (82)	5 (19)	2	1 (80)	3
Sulfamerazine	12 (125)	15 (82)	5 (19)	2	2 (80)	3
Thiosulfyl	23 (125)	17 (82)	5 (19)	5	6 (80)	
Sulfathiazole	21 (125)	36 (47)	5 (19)	5	4 (25)	
Number of Strains Tested	236	256	77	40	88	31

Figures in parentheses indicate the numbers of strains upon which the percentage was based when the number of strains differs from the total given at the bottom of page.

susceptibility of organisms to the three Tetracyclines, the figures in Table III do not bear this out. It would seem the Tetracycline, the oxy- or the chlor-forms can be used indiscriminately with little variance in sensitivity results. Interestingly, the germicidal furan derivative Nitrofurantoin shows a profile so similar to the Tetracycline that it is best considered with this group in studying sensitivity results. They are moderately effective against Escherichia coli, Klebsiella areogenes and the gram positive organisms.

Group III consisting of Chloramphenicol is the only good broad spectrum antibiotic as judged by this method.

The various organisms tested show a uniformly high sensitivity to this antibiotic with the exception of Pseudomonas aeruginosa which is not highly susceptible to any of the antibiotics tested. Of all of the antibiotics considered in this study Chloramphenicol is the most efficacious broad spectrum antibiotic as judged by the disc test results. As will be shown later, it overlaps most of the other antibiotics and often includes strains sensitive to other types as well as many of the insensitive types. In terms of its broad spectrum and the high percentage of strains sensitive to it, Chloramphenicol would be the antibiotic of choice.

Certain serious side reactions have occasionally been reported for this drug,[6,7] and while these are disputed or minimized by some writers,[8,9] it would seem wise to reserve Chloramphenicol for use when the other antibiotics fail.

Group IV consists of Streptomycin, Dihydrostreptomycin and Neomycin. Although the latter was found by Waxman[10] during his search for an antibiotic to handle the Streptomycin resistant bacteria, its total profile closely matches that of the actinomycete derivatives. It is interesting that there was no difference observed between Streptomycin and Dihydrostreptomycin. The Group IV profile is a comparatively flat curve moderately successful against all the bacteria tested except streptococci. There were insufficient cases of the anaerobic bacteria such as Clostridium and Bacteroides for evaluation in this study.

Group V consists of Polymixin B only. It is unique in that it has a high antibiotic value against Pseudomonas aeruginosa and Escherichia coli, though poor against the other organisms. Although primarily a topical medication because of its toxicity when used parenterally it is of value because of the increasing difficulty with pseudomonas skin and mucous membrane infections.

Group VI is made up of the various sulfa derivatives. It has not been plotted because disc test does not seem as reliable for the sulfas as it does for the antibiotics. An investigation of some of the sulfa results showed internal inconsistencies. It may be that the reason lies in poor solubility or slow diffusion of the drug in agar or it may be due to a more complex reason. In any event, we do not consider that the sulfa data are worth analyzing further.

The placing of the various antibiotics into the groups discussed above does not necessarily have any biological or theoretical significance, though similar spectra might imply similar actions. The main use of the profile curve is in selecting an antibiotic group for therapy with a given organism. When there are several antibiotics in the group, then the final judgment must be made in terms of the sensitivities of the particular bacterial species and strain, and in terms of that unanalyzable faculty called "clinical judgment."

It seems to us that the data presented in this paper may give some aid in selecting the antibiotic for a given pure or mixed bacterial infection. If the species of bacteria causing the infection are known and the sensitivities are known, a judgment of the most probably useful antibiotic can be obtained as follows: For a pure infection with one species of pathogen: *1.* Consult Fig. 1 and compare the sensitivity of the various antibiotic groups for the species in question and select the group or groups showing the best effect on the organism. For example, consider a Proteus vulgaris infection of the ear canal. Groups I, II and V show very little effect against this organism. Group III, Chloramphenicol, shows that 82 per cent of the Proteus strains respond to this drug, and for Group IV about 62 per cent responded. Select-

ing Group IV, a check is made in Table III where it is found that Streptomycin had a percentage value of 68 and Neomycin a value of 56 per cent. *2.* A check of the laboratory tests shows (let us say), that the particular strain involved in the infection has the following sensitivities:

Antibiotic	Sensitive
Chloramphenicol	Yes
Streptomycin	No
Neomycin	Yes

The negative response for streptomycin does not mean that this drug is not usable but it does mean that the chances of its being effective are lessened. Alternatively, the positive value for neomycin means that the probabilities of its being effective are increased as compared with the situation where the sensitivity is negative.

From this point on, a value judgment of possible dangers from side effects must be made and the clinician's judgment brought into play.

As another example, consider pneumonia due to Staphylococcus albus. A check of Fig. 1 shows that four groups are potentially useful. In order, they are:

Group III	86 per cent
Group I	74 per cent
Group IV	57 per cent
Group II	50 per cent

A test of the specific strain of the organism shows the following sensitivities:

Group	Antibiotic	Sensitive	Average Per Cent Sensitivity of Staphylococcus Aureus
III	Chloramphenicol	Yes	86
I	Penicillin	No	67
	Erythromycin	Yes	81
	Bacitracin	No	85
	Novobiocin	Yes	85
	Oleandomycin	No	73
	Cyclamycin	Yes	83
IV	Neomycin	No	64
	Streptomycin	Yes	53
II	Tetracycline Group	Yes	38
	Nitrofurantoin	No	83

Certain of the antibiotics are ruled out immediately because of their restriction to topical use. Of the others, the antibiotics to which the strain tested showed no sensitivity should be abandoned at least temporarily. The remaining ones that might be suitable are:

	Average Per Cent Response
Chloramphenicol	86
Erythromycin	81
Oleandomycin	73
Cyclamycin	83
Tetracyclines	39
Streptomycin	53

The average per cent response of strains of Staphylococcus albus to each of these antibiotics is comparatively meaningless as each of these showed a sensitivity. So, a priori, one might argue that the probability of the strain responding to any one of the above antibiotics is 100 per cent. In actual fact, there is a high, but not a 100 per cent correlation between the disc test and clinical response. Presumably the higher the per cent of strains responding, the better the chance of a given strain responding clinically and hence the better chance if the antibiotics are used selectively.

SUMMARY.

A study of the comparative *in vitro* evaluation of the various antibiotics was attempted. This study was not aimed at the accuracy of the disc method, but rather to examine the results available to the average medical practitioner.

Routine antibiotic sensitivity reports were serially abstracted from laboratory day books, in two groups. In the first, 1,000 consecutive reports were used to obtain relative abundance of various organisms and their mixtures (see Table I). The second group was used to obtain larger numbers of the rarer organisms for statistical study.

These statistical analyses showed some interesting possibilities as to antagonism and symbiotic relationships (see

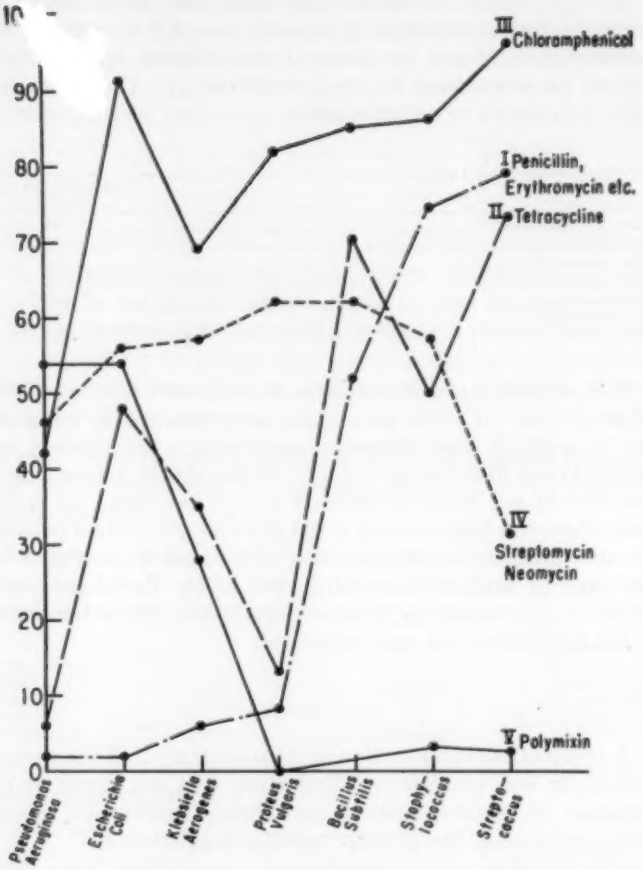


Fig. 1.

Table II). Staphylococcus albus and aureus; and Staphylococcus aureus and Streptococcus viridans showed potential antagonisms. Catarrhalis Neisseria and Streptococcus viridans, Staphylococcus aureus and Hemophilus influenzae and finally Streptococcus viridans and Beta Hemolytic streptococci had a tendency for positive association, suggesting some

symbiosis. This was interesting in view of their occasional association in clinical disease.

The results of the sensitivity tests against pure cultures of organisms was shown in Table III. A profile of drug response versus species of bacteria was presented in Fig. 1. This showed six groups, the significance of which is not understood.

It would seem that these data would aid in the selection of the antibiotic of choice for either pure or mixed infection. The method of combining the results of the sensitivity tests with the curves to select the drug with the statistically best possibilities of killing the infection, is demonstrated.

CONCLUSION.

If Tables such as are here presented are prepared and used, the antibiotic therapy best able to care for an infection can be chosen on a statistical basis.

BIBLIOGRAPHY.

1. Hill, E. O.; Altermeier, W. H., and Culbertson, W. R.: An Appraisal of Methods of Testing Bacterial Sensitivity to Antibiotics. *Ann. Surg.*, 148:410, 1958.

2. Greenberg, L.; Fitzpatrick, K. M., and Branch, A.: The Status of the Antibiotic Disc in Canada. *Jour. Can. Med. Assn.*, 76:194, 1957.

3. Jackson, G. G., and Finland, M.: Comparison of Methods of Determining Sensitivity of Bacteria to Antibiotics *in vitro*. *Arch. E.N.T. Med.*, 88:446, 1951.

4. Collins, A. M.; Craig, G., and Zaiman, E.: A Comparison Between Disc, Plate and Tube Dilution Methods for Antibiotic Sensitivity Testing of Bacteria. *Can. Jour. Pub. Health*, 45:430, 1954.

5. Yale, G. U., and Kendall, M. G.: "An Introduction to the Theory of Statistics," pp. 1-701. Hafner Publishing Co., New York, 1950.

6. Smiley, R. K.; Cartwright, G. E., and Wintrobe, M. M.: Fatal Aplastic Anemia Following Chloramphenicol Administration. *Jour. A.M.A.*, 149:914, 1952.

7. Rheingold, J. J., and Spurling, C. L.: Chloramphenicol and Aplastic Anemia. *Jour. A.M.A.*, 149:1301, 1952.

8. Woolington, S. S.; Adler, S. J., and Bower, A. G.: Five Years' Experience with Chloramphenicol. *Antibiotic Ann.*, 365, 1956.

9. Welch, H.; Lewis, C. N., and Kerlan, I.: Blood Dyscrasias. *Antibiotics and Chemotherapy*, 4:607, 1954.

10. Waxman, S. A., and Lechevalier, H. A.: Neomycin, a New Antibiotic Active Agent Against Streptomycin-Resistant Bacteria, Including Tuberculosis Organisms. *Science*, 109:305, 1949.

PITFALLS IN THE DIAGNOSIS OF CANCER OF THE LARYNX.*

WALTER H. MALONEY, M.D.,†

Cleveland, O.

INTRODUCTION.

Early diagnosis in cancer of the larynx must start with an appreciation of the importance of minimal complaints referable to this organ; in fact, there may be no complaints whatsoever, or they may appear unrelated, such as dysphagia, ear pain or a swelling in the neck. The typical complaints of hoarseness or change in the character of the voice may not be constant or progressive. They may vary in intensity as the associated benign or systemic disease varies with time and treatment. Neglect of persistent minimal complaints and the tendency to attribute them to other causes such as vocal abuse, infection, sinus disease or allergy should be avoided.

EXAMINATION.

A high index of suspicion and awareness of the hidden areas of the larynx must be coupled with a thorough and accurate examination. Double primary lesions are not limited to the related histologic types of epithelium but may be found distally. The late diagnosis of this distal lesion will greatly effect the survival of your patient. A benign appearing polypoid degeneration of the vocal cord will mask an early malignant change. An inadequate mirror examination may be worse than none at all.

Delay in direct laryngoscopy is another pitfall in the early diagnosis of cancer of the larynx. This is the only way to examine adequately the hidden areas of the larynx. Minimal

---

*Read at the meeting of the Middle Section, American Laryngological, Rhinological and Otological Society, Inc., Chicago, Ill., Jan. 18-19, 1960.

†Western Reserve University School of Medicine.

Editor's Note: This manuscript received in The Laryngoscope Office and accepted for publication Feb. 8, 1960.

mucosal changes or other benign appearing lesions which do not clear up under conservative therapy in the time interval you have come to expect, *i.e.*, two to three weeks, should be inspected and biopsied by direct laryngoscopy. Cord motion is usually best evaluated by mirror examination but direct examination may confirm a suspected impairment of motion and find a lesion infiltrating the cricoarytenoid joint. The pooling of secretions in the pyriform sinus may be the only clue to a lesion of the post-cricoid larynx or cervical esophagus.

I believe the initial biopsy in an early suspicious lesion of the cord edge should be such that if it is benign you have not made the patient permanently hoarse. It is better to rebiopsy even at the inconvenience of the patient than to destroy his speaking voice unnecessarily. This does not mean that deep biopsy should not be done if the lesion persists or the pathologist reports activity indicative of malignant changes in adjacent areas. These deeper and more radical biopsies should be reserved for the second and third examinations in early lesions. For lesions located other than on the cord edge deep biopsy is acceptable and is to be preferred.

While local anesthesia is used in a majority of cases, the apprehensive patient and those with short thick necks may require general anesthesia, and I have found that Fluothane, preceded by the ordinary local anesthesia, is best in my hands; however, general anesthesia is no substitute for good endoscopic technique. It will not eliminate the need for appreciation of minimal mucosal change, a careful unhurried examination, and a precise, accurate and adequate biopsy. One must guard against inadequate instrumentarium and untrained assistants. Retrograde and fore-oblique telescopes are useful in visualizing the hidden parts of the larynx. Be certain to inspect all of the larynx and not be fooled into stopping the examination at the first appearance of pathology. Remember the multiple primaries and malignancies hidden under benign disease.

There are other modes of examination of the larynx, and failure to use them will delay the early diagnosis of cancer of the larynx. The first is the use of laminograms. These are

especially valuable in the detection of subglottic and ventricular lesions. Double contrast studies and cinefluography using bronchographic solutions such as Dionosil are of value. Stroboscopic examinations have been used by some to good advantage. Cytologic examination of secretion taken directly from the cords may help. Finally, exploratory thyrotomy may be necessary to establish the diagnosis where all else has failed.

RECURRENCE AFTER IRRADIATION.

Previous irradiation complicates the early diagnosis of recurrence of malignancy in the larynx. This is even more true if you did not have the opportunity to see the original lesion. The picture usually resolves to one of edema, hyperplasia, distortion of the soft tissues and continued hoarseness, pain, and dysphagia. This progresses to the point where you cannot be reasonably certain that there is residual disease, recurrent disease or only the benign complications of irradiation. In these problems I feel we must continue to pursue a course of diagnostic work to establish the exact state of disease.

If within eight to ten weeks after completion of therapy there is abnormal tissue visualized, biopsy should be done again and repeated if negative until the suspicious lesion is resolved. If there is only edema and swelling which persists, the timing of repeat biopsy must be correlated with the ultimate surgery. If there is a possibility of partial laryngectomy, we must be early in our biopsy to make the diagnosis before the lesion passes beyond the limits of partial resection. If total laryngectomy is contemplated we usually have time to allow further resolution of the edema since the danger of metastasis is lessened by the obliteration of lymphatic pathways by the primary irradiation and conservation of function of the larynx is no longer an issue.

RECURRENCE AFTER SURGERY.

Another problem is that of diagnosis of recurrent disease after previous surgery. The careful histologic examination

of the operative specimen may point toward the site most likely to have recurrence or residual disease, *i.e.*, the cut edge with hyperactivity of the basal layer of cells, abnormal nuclei, and hyperkeratosis. In these cases, early biopsy of any abnormal tissue is indicated and if positive allow a more conservative approach to therapy. Previous surgery may also complicate the problem by burying the cut edge with residual disease deep in normal tissue. It may distort the anatomy so that casual inspection is not feasible, and each examination necessitates inconvenience and discomfort to the patient. The practice of pulling arytenoid mucosa into the larynx to cover denuded areas often complicates the examination and airway; therefore, an effort should be made at surgery to leave an operative field which is accessible to re-examination.

Both post-irradiation and post-surgical problems are complicated further when there is obstruction of the airway by edema and scarring. Repeated attempts at biopsy may very likely precipitate the need for tracheotomy. In such cases I prefer to defer biopsy for as long as possible and reduce the edema to its fullest prior to examination.

When direct laryngoscopy and biopsy fail, the next step is exploratory thyrotomy with frozen section and a previous agreement with the patient as to contemplated surgery. Again, we must consider that if the tissue is benign that there is a possibility that the postoperative edema may decrease the airway to the point where tracheotomy may be necessary. Surgical exploration of an irradiated larynx may cause necrosis of the cartilage.

CHRONIC LARYNGITIS.

The chronic irritated larynx raises a special problem. First, careful periodic examination is essential to establish a base line. In turn, deviation from this basic picture then becomes important and warrants investigation. I believe that the equivocal lesion which does not resolve must be biopsied and rebiopsied until it either resolves or a positive diagnosis is made. If it does resolve then we must remember that there may be multiple foci or pre-malignant change and periodic re-

examination becomes important and rational; moreover, the precursors of malignancy, *i.e.*, excessive smoking, infection, and vocal abuse must be guarded against.

PREVIOUS BIOPSIES.

The problem of previous biopsies raises both a technical problem and a personal problem, inasmuch as we now must consider the capability of the referring endoscopist. I do not think that anything but an obvious gross lesion should be biopsied by other than the physician charged with the decision as to ultimate therapy. Biopsy may complicate the picture by doing the following things: *1.* introduce infection; *2.* cause edema and swelling, thus limiting motion; *3.* remove and eliminate the only suspicious tissue which might urge you on to further studies. As a result this latter presents your consultant with an apparently benign picture but in reality one with a hidden lesion which must await further growth before it can be discovered. Finally, it may destroy the margins of the lesion and make it necessary to do more radical surgery than might have been necessary if the true edge of the lesion could have been adequately visualized.

PATHOLOGY CONSULTATION.

Close co-operation with your pathologist may make the difference between success and failure in early diagnosis. Take the time to give him a careful history and discuss with him the general factors in the case. Make him aware of other associated disease such as hypothyroidism, tuberculosis, and biopsy material from other seemingly unrelated procedures. Evaluate the degree of infection present so that he in turn can evaluate its relationship to cellular activity. We must be aware that cellular changes such as dyskeratosis, hyperkeratosis and atypical maturation, hyperactivity of the nuclei and irregularity of the basal layer are changes seen next to malignancy and indicate the need for repeated biopsies in the adjacent areas. Careful orientation of the biopsy specimen in relation to the whole larynx will be of great help to him. This is done by careful labeling of specimens, use of drawings,

and even the attendance of the pathologist in the operating room at the time of examination.

Previous positive biopsy done elsewhere should be reviewed by you and your own pathologist. If not absolutely conclusive a second biopsy should be obtained by the operating surgeon since the medical-legal responsibilities are such that he must be certain beyond any doubt that he has an accurate diagnosis. This same index of suspicion applies to the benign diagnosis as well as to the malignant one.

The pathologist is often placed in a most difficult position when we expect him to deliver us a clear cut unequivocal diagnosis. The borderline problem of hyperkeratosis, atypical maturation, associated infection and irregular sectioning of the tissue block may make it impossible to be didactic; therefore, we should make this problem one for continued orientation and study with the pathologist. He should be encouraged to state his observation precisely, accurately and objectively, then he should draw his conclusions. We in turn must be prepared to take these same findings with his impression, make our own diagnosis and assume the responsibility for the final decision.

2065 Adelbert Road.

THE JAMES E. NEWCOMB AWARD.

Dr. Joel J. Pressman, of Los Angeles, was chosen by the members of the American Laryngological Association at its annual meeting recently, to be the recipient of the James E. Newcomb Award for his outstanding contribution to research in otolaryngology.

LARYNGOGRAMS: THEIR VALUE IN THE DIAGNOSIS AND TREATMENT OF LARYNGEAL LESIONS.

A Study Based on Clinical, Radiographic and Pathologic Findings on 99 Patients with Cancer of the Larynx.*†

JOSEPH H. OGURA, M.D.,
WILLIAM E. POWERS, M.D., (By Invitation),
SUMNER HOLTZ, M.D., (By Invitation),
MALCOLM H. MCGAVRAN, M.D., (By Invitation),
BRUCE ELLIS, M.D., (By Invitation),
and
RICHARD VOORHEES, M.D.,‡ (By Invitation),

St. Louis, Mo.

The laryngogram, a method for objective radiographic demonstration of laryngeal lesions, has been used by the radiologist to delineate masses within and about the larynx, to indicate extent of the lesion and to demonstrate impaired function of adjacent structures. This method of examination should not be used as a screening procedure, but it should serve as an ancillary aid in diagnosis and treatment. Its value to the radiotherapist is to document objectively the effects of radiation on malignant tumors.

The otolaryngologist has resorted to indirect and direct examination and biopsy procedures to establish the nature of the lesion and institute appropriate surgical measures. On occasions, he has utilized tomography to show soft tissue densities, but this has the disadvantage of not clearly demonstrating the detail of certain specific structures under question, *e.g.*, false cord and ventricle with false cord tumors.

Many benign lesions within the larynx have been adequately

*Read at the Sixty-Third Annual Meeting of the American Laryngological, Rhinological and Otological Society, Inc., Miami Beach, Fla., March 16, 1960.

†From the Departments of Otolaryngology, Radiology and Surgical Pathology, Washington University School of Medicine, St. Louis, Mo.

‡Formerly Department of Otolaryngology, now at Salt Lake City, Utah.

Editor's Note: This manuscript received in The Laryngoscope Office and accepted for publication April 6, 1960.

demonstrated by laryngograms. Lesions such as cysts, prolapse of the ventricle, amyloid disease, chondroma, bronchial adenoma, irradiation ulcers, and paralyzed cords have been objectively recorded, and have correlated with clinical findings; however, all of the discussion in this paper will concern malignant neoplasm and evidence to support the value of laryngograms will be presented.

If treatment was based on radical extirpation of the larynx alone in every extensive lesion regardless of location or extent of tumor, one could say that any data on accuracy of diagnosis is immaterial since any other surgical procedure would not be considered; however, conservation of laryngeal function by varied surgical approaches to the supraglottic and hypopharyngeal areas should be possible if accurate appraisal of the extent of the primary lesion can be made. How often have we been impressed by freedom of involvement of tumor in the true cords area with supraglottic cancer after total laryngectomy, and wonder whether a supraglottic operation might not have been better?

In order that laryngograms demonstrate their true value to the clinician, graphic objective findings should highly correlate with pathology specimens; furthermore, if laryngograms are that important, one should be able to separate lesions which can be operated upon by less radical procedures (supraglottic subtotal laryngectomy or transhyoid partial laryngo-pharyngectomy) which conserve function.

Conversely, if such radiographic findings might indicate a more radical operation (inclusion of neck dissection), it would follow that this diagnostic measure is of immense importance. To back these assumptions, a brief review of surgical pathology data will be presented from our cases operated upon by uniform treatment during the last decade.

PATHOLOGIC SIGNIFICANCE OF LOCATION AND SIZE OF PRIMARY LESION.

Classification of laryngeal lesions differs in various sections of the country and over the entire world.[1-11] One with any experience in laryngeal cancer will admit that we have

two serious problems: first, the clinical classification of cancer of the larynx; second, its relationship with the metastatic rate. Each proposed classification scheme has its advantages and disadvantages. We can best illustrate this situation if we have 100 laryngeal cancers and they are split into five or ten groups, and then into clinical stages.

Such information derived, while specific, will be based on a small limited experience of that individual. While several methods for study of metastatic spread have been reported,

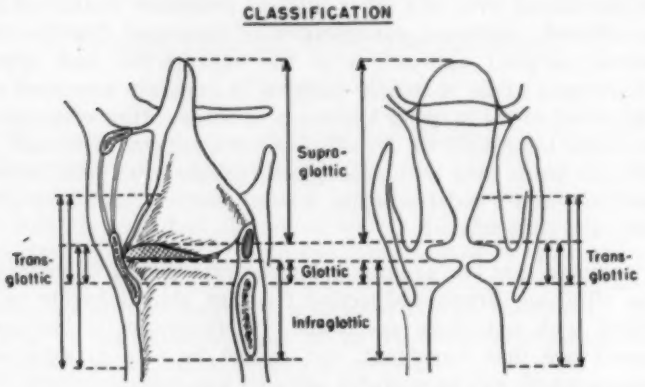


Fig. 1. Clinical, pathologic and laryngographic classification.

seldom has the information been derived from a homogenous sample where the treatment has been uniform.

Recently McGavran, Bauer and Ogura[12] have reviewed the specimens of laryngeal cancers where *en bloc* total or supraglottic subtotal laryngectomy with incontinuity neck dissection was performed between 1950-1959. No case with prior radiation treatment or other surgical intervention has been included. All ary-epiglottic fold and pyriform sinus cancers known to have a high metastatic rate and cancers earlier than 1950 are excluded in this pathologic study.

The proposed classification (see Fig. 1) based on pathologic data are:

I. Glottic—cancers limited to the true cord.

II. Infraglottic—cancers of the subglottis and glottis.

III. Supraglottic—cancers involving the false cord, fixed and free portion of the laryngeal surface of the epiglottis.

IV. Transglottic—cancers that cross the ventricle, thus involving two or three of the above sites. The rare ventricular tumor is included in this group.

This classification has been based on areas of involvement and does not include the hypothetical extrapolation from size and location as to the point of origin. It is based on where tumor *is* rather than a supposition as to where it began. The glottic, infraglottic and supraglottic types are similar to that used by Pietrantoni.[4,5]

This classification area scheme has the value of separating lesions according to two major divisions of lymphatic drainage. Of the 96 patients studied, the following facts were noted:

There was a progressive increase in metastatic incidence from glottic, infraglottic, supraglottic and transglottic, 0, 19, 33 and 52 per cent respectively. The metastatic rate of the transglottic group represents the addition of the infraglottic and supraglottic, confirming the expected results derived from theoretical considerations of the lymphatic drainage of the larynx.

The transglottic group yielded a higher incidence of both clinical apparent and inapparent metastases. The metastatic rate for inapparent metastases for the infraglottic group was 5/23 or 22 per cent, the supraglottic 1/25 or 4 per cent and the transglottic was 5/16 or 31 per cent. Supraglottic and infraglottic cancers larger than 2 cms. and of moderate or poor differentiation also constituted a high incidence of metastases (15/39). Cancers in these two locations that are well differentiated of any size; those of 2 cms. or less and moderately or poorly differentiated provided a poor yield of metastases to the neck (two of 20). Of the 23 patients with supraglottic or transglottic lesion shown to have cervical

metastases, 11 (48 per cent) had proven positive nodes in the contralateral side of the neck on follow-up surgery. Consideration in these cases should be given to bilateral neck dissection (one or two stage).

Supraglottic tumors tended to be the "pushing" type rather than the "infiltrating" type, particularly when they are relatively well differentiated. They had sharp margins of extent, and showed less tendency to metastasize.

Thus cases of laryngeal cancer can be separated into groups with high and low metastatic rates by using preoperative information about site, size, biopsy differentiation and clinical evaluation of cervical lymph nodes.

TECHNIQUE OF LARYNGOGRAMS.

The procedure used was essentially that as reported by Powers, McGee and Seaman.[13] Since 1958, however, we have modified the technique by using 10 per cent cocaine for topical anesthesia rather than 5 per cent cyclaine. The standard method of anesthesia of the hypopharynx and larynx is used with the Jackson cross-action forceps and 2 cc. of cocaine is dropped into the larynx. The use of oily dionisil gives the best coating and has the theoretical advantage of minimizing granuloma formation in the lung.

Ten to 20 cc. of oily dionisil is dropped slowly over the tongue intermittently during inspiration. Frontal and lateral spot films are made using high kilovoltage during phonation, inspiration, Valsalva and modified Valsalva maneuvers.

There are some difficulties inherent with this simple method of performing laryngograms. (In 2 per cent of our cases, it was impossible to perform a laryngogram because of the apprehensiveness of the patient.) It is important to stress that laryngograms should be performed *before* biopsy. Edema following laryngoscopy and biopsy will cause some distortion on the films.

METHOD OF STUDY.

Since this study was designed to appraise accurately the

diagnostic validity of laryngograms, it necessarily follows that the clinical findings, radiographic, and pathologic data are documented separately.

Ninety-nine laryngograms from 1957-1959 were examined on proven epidermoid carcinoma of the larynx where subsequent surgery was performed, and the specimens were available for comparison. Six of 13 glottic lesions were hemilaryngectomies, and the remainder was incontinuity neck dissection with total or subtotal laryngectomy. Without regard to previous interpretation these films were reviewed by the radiologists.

All of the laryngograms were re-examined without regard to known classification or knowledge of clinical data. There was never any major difference of opinion between the radiologists; however, if opinions differed over certain small structural involvement, *e.g.*, false cords or anterior commissure, such differences were resolved into one opinion and recorded together with a drawing of the size and shape of the tumor. The following facts were noted:

I. Classification.

1. Glottic.
2. Infraglottic.
3. Supraglottic.
4. Transglottic.
5. Pyriform sinus.

II. Area of Involvement.

1. Size.
2. Structures involved.
3. Adjacent structures invaded or free.
4. Upper and lower border of tumor.
5. Mobility of cords.
6. Cartilage destruction.
7. Anterior commissure and across midline.
8. Pyriform sinus, ary-epiglottic fold and base of tongue.

These were then placed into various classifications, the size estimated in the superior-inferior extent, and notations were

made of the adjacent structural involvement. Comment was made whether radical excision in supraglottic or pyriform sinus lesions was necessary or conservation of function operation could be performed (supraglottic subtotal or transhyoid partial laryngo-pharyngectomy). The clinical and direct laryngoscopic observations were then recorded from the hospital record on a master sheet and final comparisons made with the gross photograph of the specimen and the pathology records.

During the 1957-1959 period, the following cases were excluded from this study:

Seven laryngograms made on laryngeal cancer during this period were discarded for the following reasons: *1.* poor coating, two cases; *2.* poor quality or insufficient views, two cases; *3.* following irradiation with edema and distortion, two cases; *4.* tracheotomized patient—insufficient coating and poor airway, one case. Four laryngograms were done and surgery performed, but these could not be found in the X-ray file. It was impossible to do laryngograms on two patients because they were uncooperative.

Twenty-five patients had laryngograms; but these were not included since irradiation was the treatment of choice, and no specimen was available. Ten other cases had far advanced cancer and surgery was not considered.

Twenty patients with laryngeal cancers underwent surgery without laryngograms during this period. Three laryngograms were done where neither surgery nor X-ray therapy was given to the patient.

These represented a total of 170 cases of all forms of laryngeal cancer during this three-year period.

RESULTS.

The lesions demonstrated by laryngograms were classified on the basis of certain structural involvement according to the foregoing proposed pathologic classification. Accuracy was verified by correlating these findings with the surgical specimens and gross photographs.

Errors were listed if the laryngographic interpretation resulted in a different classification because of certain adjacent structural involvement incorrectly appraised.

Clinical information was derived from the hospital records as to physical examination and direct laryngoscopic examination. These were listed as to structures involved. These findings represented the combined notes of the residents and

TABLE I.

Classification.

	Clinical and Direct Laryngoscopy		Laryngograms		Surgical Pathology
Glottic—					
Correct	12		12		13
Errors	1		1		
Infraglottic—					
Correct	7		9		14
Errors	7		5		
Supraglottic—					
Correct	22		28		29
Errors	7		1		
Transglottic—					
Correct	10		16		16
Errors	6		0		
Pyriform Sinus—					
Correct	26		26		27
Errors	1		1		
Total—					
Correct	77	22%	91	8%	99
Errors	22		8		

the attending surgeon. The same criteria for accuracy and errors were used as were used for laryngograms.

Glottic (See Table I):

Clinical evaluation of true cord involvement as to extent, and fixation of the cord was accurate in 12 of 13 cases. One error was recorded. Subglottic extension was absent in the specimen.

Laryngograms on cordal lesions were accurately demonstrated in 12 of 13 cases (see Fig. 2). In one, the false cord was thought to be involved. It is important to stress the side

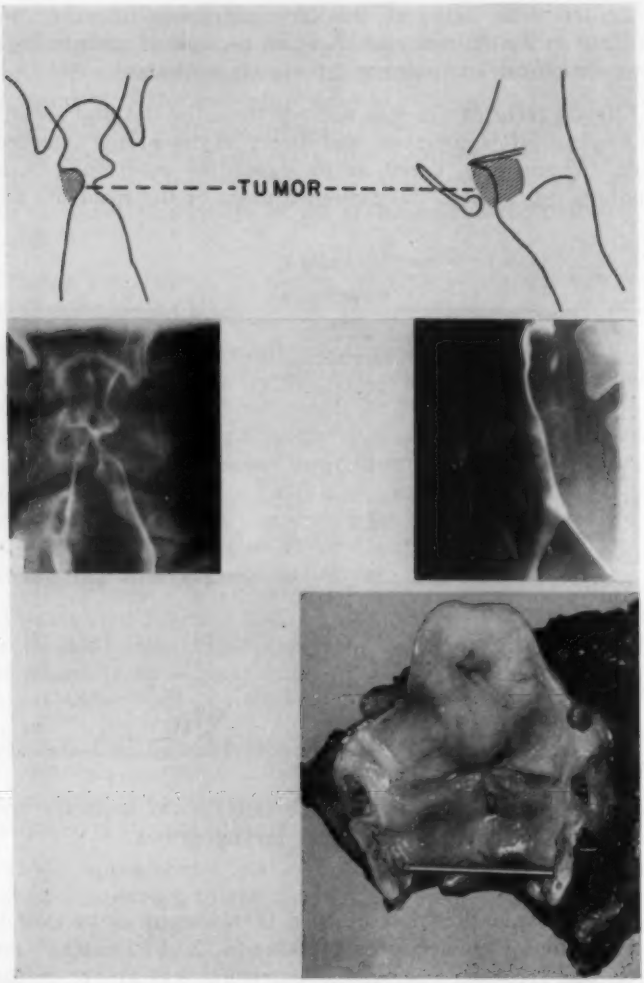


Fig. 2. Glottic: Frontal view—Note the thick right true cord. The right ventricle is smaller than the left. There is no subglottic extension and the false cords are normal.

Lateral view—There is irregularity of the anterior portion of the true cord and a double contour anteriorly indicating anterior commissure involvement.

Specimen—Tumor is confined to the anterior two-thirds of the true cord and extends several millimeters into the subglottis.

of involvement was called in every instance. The mobility of the cord as demonstrated by indirect examination correlated with the laryngograms in every instance.

Infraglottic (See Table I):

Accuracy both as to clinical and laryngogram data was least in this group. Clinically, a correct diagnosis was made in seven of 14 patients. There were seven errors. In two instances of cordal fixation, the subglottic mass was not suspected until a biopsy was taken blindly from the subglottic area. In five instances, false cord involvement was suspected, and the true nature demonstrated by the negative biopsy of this area.

Laryngogram accuracy was demonstrated in nine of 14 cases (see Fig. 3). Four errors were primarily made in classifying these lesions as transglottic since the false cords were thought to be involved. Non-filling of the ventricle and edema distortion of the false cord (post laryngoscopic biopsy) may account for some of these errors. One small subglottic tumor was missed by laryngograms. In five cases, the tumor was demonstrated across the midline by laryngograms and in the specimens.

Supraglottic (See Table I):

From clinical information on 29 patients, 22 were accurately placed in this group. Five of the 29 extended into the vallecula or anterior pyriform sinus (see Fig. 4). All seven errors were in the true cord area, where true cordal involvement was thought to be present.

With laryngograms, 28 of 29 were correctly placed in the supraglottic group, and one error was recorded where the true cord was thought to be involved. In 17 instances, the radiologist was able to appraise that conservation of function operations could be performed. These 17 cases correlated with the actual number of conservation of function operations performed. All 17 cases had a good margin of safety in the surgical specimen. Twelve of this group were in the area of the petiole and higher (see Fig. 5) and five were in the false cord area and above. In three instances of the five inferior

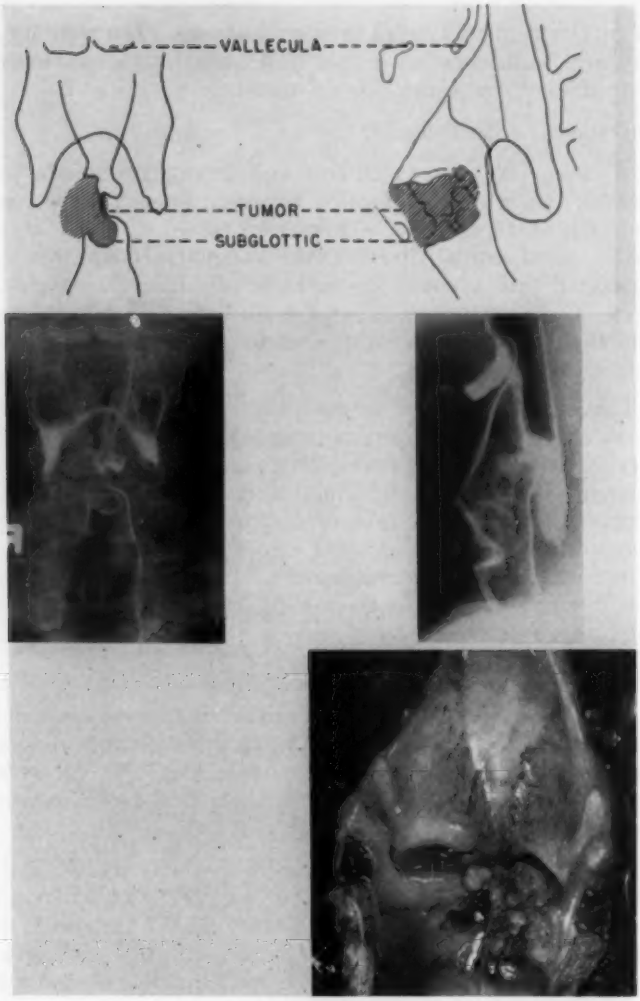


Fig. 3. Infraglottic: Frontal view—An exophytic tumor replaces the right true cord and involves the subglottic area. The ventricle is partially obliterated by the mass, but the lateral portion of the ventricle and false cord appears normal.

Lateral view—The bulky tumor is seen in its full subglottic extent. The anterior commissure is involved with tumor.

Specimen—Note the obliteration of the ventricle by the cordal-subglottic tumor.

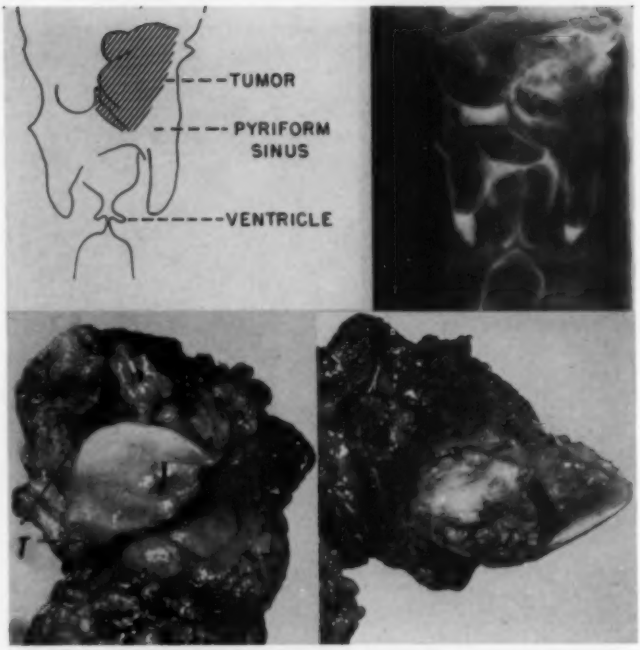


Fig. 4. Supraglottic: Frontal view—The right vallecula is distorted and obliterated by a tumor mass that extends down onto the left medial margin of the epiglottis. The tumor extends to the midline. The true and false cords are normal. There is an adequate inferior margin of safety for the conservation operation.
Specimen—Note the tumor (T) extends from the lateral wall of the epiglottis to the left vallecula.

supraglottic tumors operated upon by the supraglottic operation, the laryngogram findings gave the surgeon confidence that the operation could be performed (see Fig. 6).

Of the remaining 12, obviously the surgeon felt that laryngectomy and neck dissection was the safest procedure. From the laryngographic evidence it would have been theoretically possible to perform a supraglottic subtotal operation in 11, and only one, invasion of the anterior commissure area, was so close a subtotal operation could not have been considered. There was an error in clinical evaluation in six of the 11 surgical specimens. (These were not listed as additional

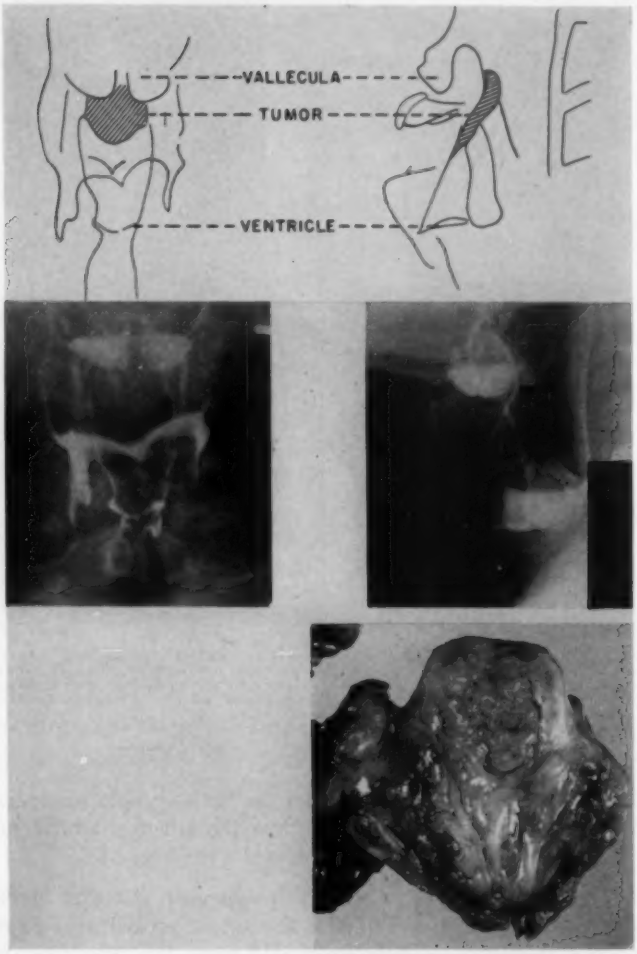


Fig. 5. Supraglottic: Frontal view—There is an ill-defined density in the midline on the free portion of the epiglottis. The lower border of the tumor is high above the cords.

Lateral view—The laryngeal surface of the epiglottis is irregular and the epiglottis is thickened. The tumor is seen to extend to just superior to the petiole.

Specimen—Note that there is a wide margin of safety in the specimen.

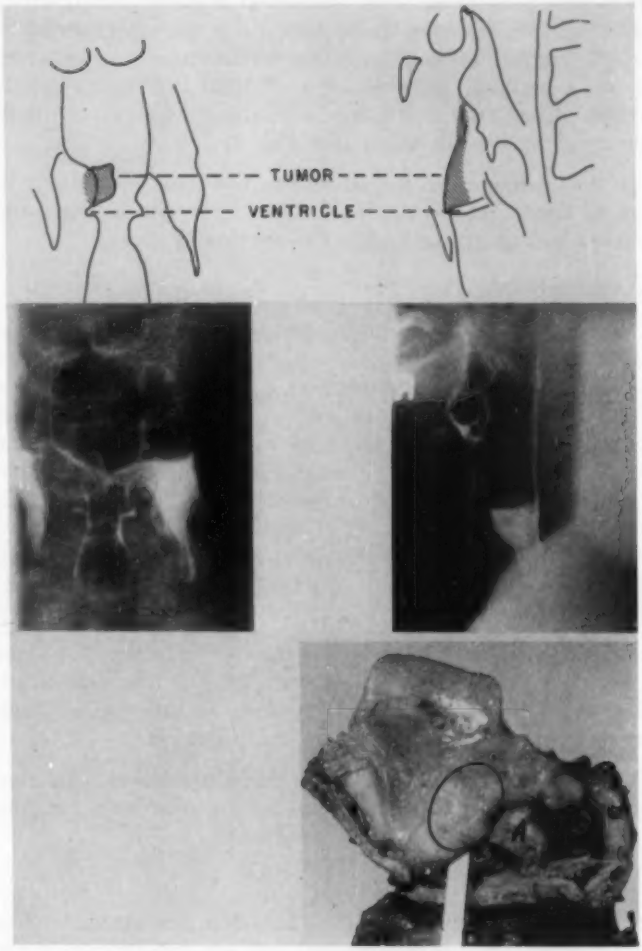


Fig. 6. Supraglottic: Frontal view—A tumor mass is present on the right false cord. The ventricle and true cord are free of tumor. There is an adequate margin of safety for a conservation operation.

Lateral view—Note the tumor extension on the false cord.

Specimen—The wooden applicator is inserted into the ventricle. A.—arytenoid.

errors.) An adequate margin of safety to the true vocal cords was present in those subjected to total laryngectomy (see Fig. 7); however, these operations were performed before the significance of laryngogram findings was apparent. In the remaining six instances of total laryngectomy, the surgical margin to the true cord area was too narrow to justify this conservation operation (see Fig. 8).

In 23 instances the tumor was in the midline. In six instances, the unilateral position of the tumor was demonstrated both by laryngograms and in the specimen.

Transglottic (See Table I):

In the group of 16 patients, clinical accuracy was assessed correctly in ten, but it was missed in six instances. Subglottic involvement was not suspected when the true cord was fixed in three cases. False cord and ventricle involvement was missed in two instances, and base of epiglottis invasion was missed three times. In two cases, two adjacent area involvements were simultaneously present and not suspected. In two additional instances only "slight subglottic extension" was suspected when actually extensive infraglottic involvement was demonstrated by laryngograms. These two were not listed as additional errors to the six listed.

Laryngogram accuracy was highest in this group. There were no errors in classification (see Fig. 9). The four errors listed under the infraglottic group were actually called transglottic because of suspected false cord invasion.

The majority of these tumors were unilateral. In four instances, the tumor crossed the midline on laryngograms and this was confirmed on the specimen.

Pyriform Sinus (See Table I):

There were 27 pyriform sinus cancers in this group. While these tumors are hypopharyngeal and are not strictly laryngeal in origin, these have been included in this study since surgical treatment employed is most frequently laryngectomy and neck dissection (see Fig. 10), use of partial or complete skin grafts for complete reconstruction of the pharynx, or

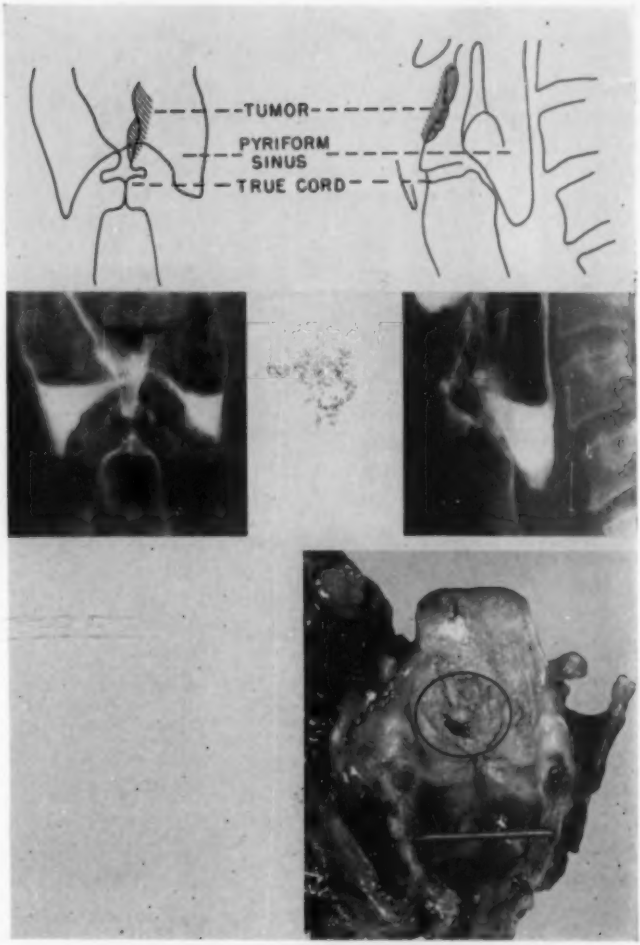


Fig. 7. Supraglottic: Frontal view—On the superior portion of the false cords there is narrowing of the vestibule and irregularity of the mucosal surfaces indicating presence of tumor. The true cords, subglottic area and ventricles are free of tumor. There is a good margin of safety for a conservation operation.

Lateral view—The laryngeal surface of the epiglottis is lobulated and irregular. The tumor extends below the petiole, but well above the ventricles.

Specimen—Note that it was possible to perform a supraglottic operation.

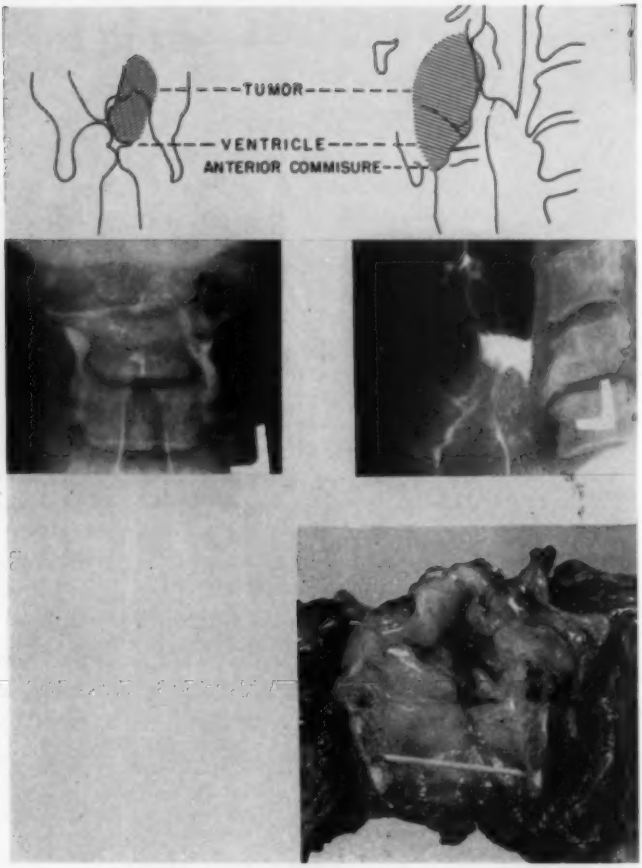


Fig. 8. Supraglottic: Frontal view—A tumor mass distorts the laryngeal vestibule bilaterally, but mainly on the right. The true cords are free of tumor.

Lateral view—A bulky ulcerated tumor involves nearly the entire laryngeal surface of the epiglottis with invasion of the pre-epiglottic space. The inferior margin of the tumor extends into the anterior commissure. There is no margin of safety for a conservation operation.

Specimen—Note extensiveness of the tumor with marginal invasion of the anterior commissure.

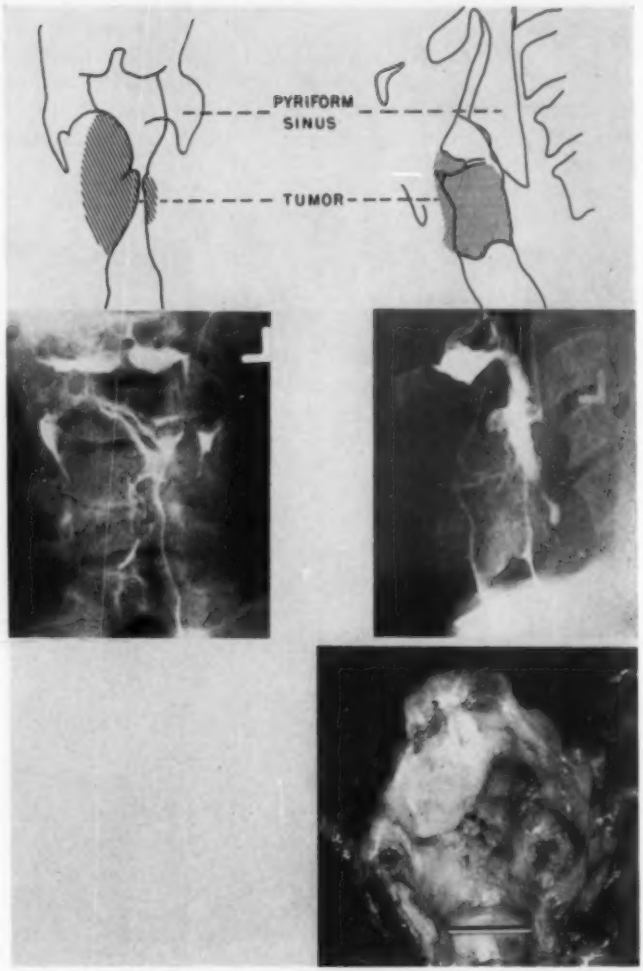


Fig. 9. Transglottic: Frontal view—The right laryngeal ventricle is obliterated by tumor which extends from above the false cord to a point two centimeters into the subglottis. The cord is fixed.

Lateral view—The tumor mass begins above the false cord. The inferior margin is near the lower border of the cricoid cartilage. Note that the anterior subglottic area is irregular. The thyroid cartilage is destroyed.

Specimen—Note the extensive tumor crossing the ventricle and cords.

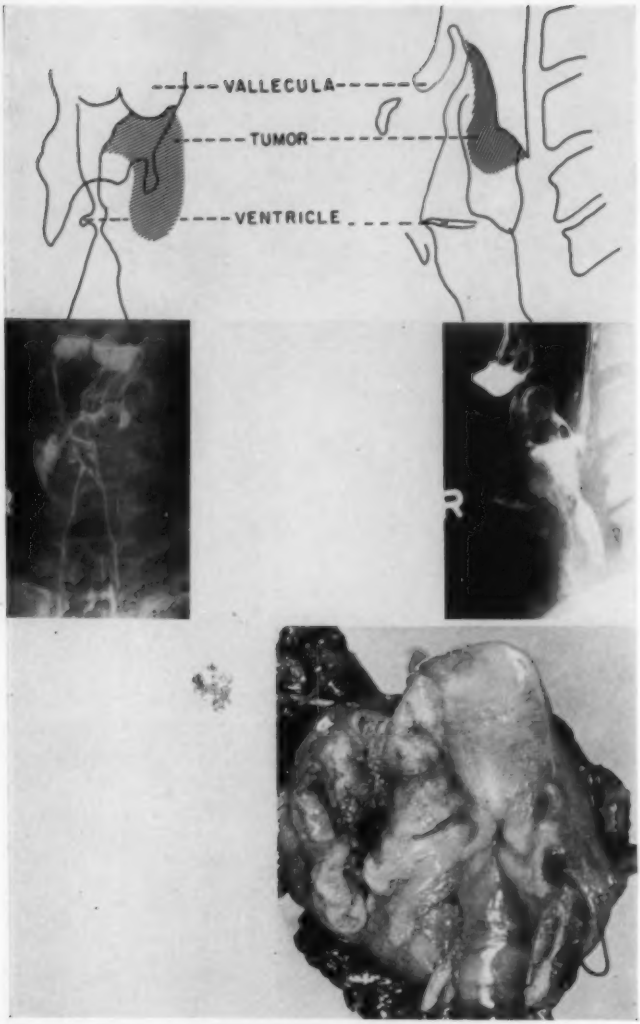


Fig. 10. Pyriform Sinus: Frontal view—The left pyriform sinus is almost completely replaced by a circumferential tumor that extends from the level of the vallecula to the apex of the pyriform sinus. There is tumor involvement of the ary-epiglottic fold. The vestibule, false cords, and true cords are displaced and edematous.

Lateral view—The free edge of the epiglottis and the ary-epiglottic fold are irregular due to tumor. The anterior wall of the pyriform sinus is involved.

Specimen—Note the large size of the pyriform sinus carcinoma.

conservation of function, *i.e.*, transhyoid partial laryngopharyngectomy.

Accuracy of diagnosis in this group has been high. Clinically and radiologically in 26 of 27 cases the lesions were accurately placed. In six of the 27, conservation of function operation was performed. These were correctly described in five of the six cases by the radiologist.

The following criteria were used for conservation of function operation. These tumors should be small (under 2 1/2 cms.), be free of thyroid cartilage invasion, demonstrate mobility of the arytenoid, and have a tumor-free apex in the pyriform sinus (see Fig. 11). Preferably they should be placed on the lateral hypopharyngeal wall. Direct examination of the posterior cricoid area should show no evidence of tumor.

Clinically one error was found. A small 1 cm. lateral wall tumor was missed completely and was picked up by the radiologist (see Fig. 12). The lone laryngogram error was an edematous ary-epiglottic fold together with non-filling of the pyriform sinus. The tumor was interpreted primarily on the ary-epiglottic fold; actually it was on the medial wall of the pyriform sinus.

SIZE OF PRIMARY LESION FROM LARYNGOGRAMS.

The correction factor for magnification of the laryngeal structures on roentgenograms was determined by using a radio-opaque measuring ruler or a metal object of known size. This factor for distortion was 20 per cent for the frontal views and 33 1/3 per cent for the lateral views. All laryngogram measurements of the tumor were made of the superior-inferior extent, and no attempt was made to measure the transverse or anterior-posterior dimension.

All laryngographic measurements were recorded first and final accuracy compared with the pathology records and gross photographs for orientation.

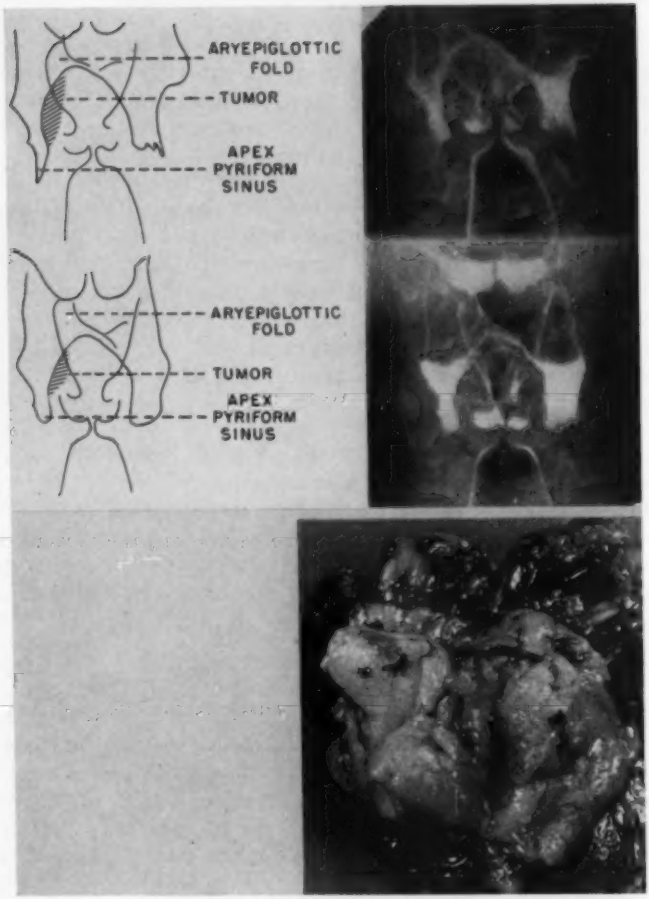


Fig. 11. Pyriform Sinus: Frontal view—There is tumor distortion of the inferior medial wall of the right pyriform sinus. The apex of the pyriform sinus is free of tumor. The laryngeal structures are normal except for marked edema of the right ary-epiglottic fold and arytenoid eminence.

Specimen—A.—arytenoid. There is an adequate margin of excision on the specimen.

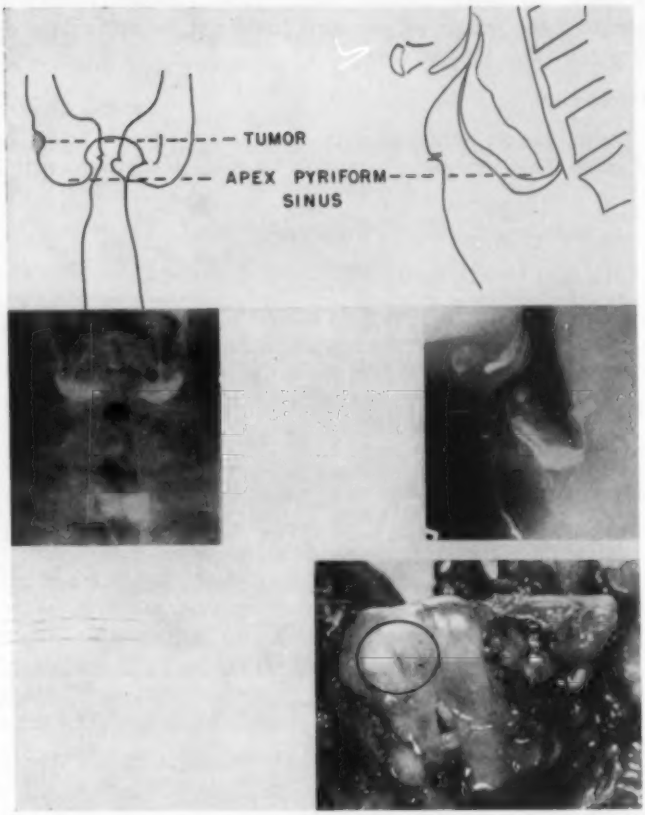


Fig. 12. Pyriform Sinus: Frontal view—A small (1 cm.) irregularity is present in the lateral wall of the hypopharynx (modified Valsalva). The apex of the pyriform sinus is free of tumor.
Specimen—Note the sharp elevated tumor margins.

Glottic.

From Table III, one can see that the size of the tumor seen on laryngogram varies as to location. Since glottic lesions are confined to an area between the floor of ventricle to a point where the lower border of the intrinsic muscles end

(1 cm.), no measurements were made. Anterior-posterior extent of the tumor of the cord could not be accurately determined from lateral views.

Infraglottic.

There was an actual variation in size of tumors from 1.3-2.6 cms. The margin of error is least in this group, with a

TABLE II.

Classification. Errors.

	Clinical and Direct Laryngoscopy	Laryngograms	Total Pathology
Glottic	1 subglottic	1 false cord	13
Infraglottic	5 false cords 2 subglottic	4 ventricle, false cord 1 subglottic	14
Supraglottic	7 true cord	1 true cord	29
Transglottic	6 (3 base epiglottis; 2 false cord—ventricle; 3 subglottic)	0	16
Pyriform Sinus	1 missed tumor	1 A.E. fold	27
Total	22	8	99

TABLE III.

Size of Primary Lesion.

	Actual Size	Average Laryngogram Variation
Glottic	—	—
Infraglottic	1.3 - 2.6 cms.	±0.3 cm.
Supraglottic	1.0 - 5.0 cms.	±0.6 cm.
Transglottic	1.8 - 5.0 cms.	±0.4 cm.
Pyriform Sinus	1 - 6 cms.	±0.6 cm.

±0.3 cm. on variation from the true size. There was little difference in error whether the tumor was greater or less than 2 cms. in the superior-inferior dimension.

Supraglottic.

The size of the tumor varied from 1-5 cms. in greatest length in the superior-inferior extent, and the margin of variation was ± 0.6 cm.

Transglottic.

Tumors in this group vary from 1.6-5.0 cms. on the specimen with a mean error variation of ±0.4 cm. by laryngograms.

Pyriform Sinus.

These tumors varied in actual size from 1-6 cms. with an error of ±0.6 cm. by laryngograms.

DISCUSSION.

Limitations of Laryngogram Interpretation (See Table II).

The successful interpretation of laryngograms depends on the skill and speed of performance of the procedure and the experience and interest exhibited by the radiologist. At the present time there are four areas where some difficulty has been experienced in the accurate interpretation.

Anterior Commissure of True Cord. When the anterior commissure area was deformed on laryngogram in glottic, infraglottic and transglottic groups, tumor was demonstrated pathologically in seven of eight instances. On the other hand, when the laryngograms were negative, there was invasion microscopically in five of 13 instances. This degree of error can only be explained by submucosal or relatively superficial invasion, insufficient to give gross distortion visible by laryngograms. One can conclude that this area is not correctly assessed by laryngograms.

True Cord Mobility. There was a high correlation between clinical and radiologic findings in every instance when the cord was mobile or completely fixed. When lag of the cord was evident by neuromuscular involvement or mass tumor weight, such a cord appeared mobile to the radiologist.

False Cords. The most frequent error was in interpretation of the false cords in the infraglottic group. It is important to stress that more errors were made clinically as well on this particular structure. Since biopsies were taken from these areas, postoperative edema will result. The majority of these laryngograms were made after biopsy examination, and it is logical to assume that some of these errors in interpretation

could have been avoided if laryngograms were done prior to biopsy.

There are additional anatomical factors to explain some of these errors. Examination of these specimens demonstrated that the false cord displacement superiorly by the cordal-subglottic lesion obliterated the ventricle. Review of these errors on laryngograms showed that actually this was the case, and it is likely that these errors of interpretation will be less in the future.

Aryepiglottic Fold. When edema or distortion of this fold was present it was difficult to rule out tumor invasion. Tumor can be suspected only when definite scalloping and irregularity of radiographic outline is present.

Postcricoid. Laryngograms were never designed for the diagnosis of lesions in this area, and no interpretation can be given by the method of examination being discussed.

Significance of Laryngogram Findings.

Laryngograms have demonstrated their great value as an adjunct diagnostic procedure for laryngeal cancer. When these findings are correlated with indirect and direct laryngoscopy and biopsy report, together with cervical node findings, the otolaryngologist can separate his cases into groups with high and low metastatic rate and arrive at a definite scheme for treatment.

Accuracy of laryngogram classification was high, 92 per cent as contrasted to 78 per cent by conventional clinical appraisal. There was an 8 per cent error in laryngogram classification, with the majority of the errors in the infraglottic group. There was a much greater error rate by clinical means (22 per cent). With continued refinement in laryngogram technique and greater experience in interpretation, the false cord error rate should be less in the future. Other errors of interpretation are extremely low and are to be expected.

Certain clinical situations have always made accurate clinical classification difficult. Bulky supraglottic tumors are air-

way problems and the precise lower margin is always difficult to determine. While lesions above the petiole of the epiglottis are easily determined and one can perform the supraglottic subtotal laryngectomy operation with confidence, the greatest problem confronting the surgeon who wishes to conserve function is with lesions of the false cord and base of the epiglottis. In the latter group, laryngograms can very accurately discern freedom of involvement of the true cord. Bulky tumors of the false cord that overhang the true cord can be precisely visualized by laryngograms. It is in this situation that clinically one has most frequently mistaken tumor to involve the true cord.

The accuracy of the radiologist in classifying a lesion as supraglottic was high. In 17 instances where the supraglottic operation was performed, 12 were listed as wide surgical margins of safety and proven by the examined specimens. In five cases where tumor was in the false cord area and petiole, these were accurately visualized and again correlated well with the safety margin of the surgical specimen. Of the 12 patients with laryngectomy and neck dissection performed, six cases could have had a supraglottic subtotal operation. The latter operation was not performed because in the clinical preoperative appraisal, it was felt there was "insufficient margin of safety."

The purpose of bringing this point up is to emphasize that accuracy of diagnosis is necessary for the purpose of evaluating whether conservation of function operation can be performed rather than write the case off to the more easily executed total laryngectomy. While this paper does not deal with end results of the supraglottic subtotal operation, these highly selected cases are quite successful for a one to six-year follow-up.[14,15] Perhaps the high frequency of the "pushing" type of lesion in the supraglottic group accounts in part for success with this relatively narrow surgical margin of safety.

Clinical estimation of extent of cancer involving the infraglottic and transglottic groups has been frequently in error. The error in judgment in both groups is explained by fixation of the cord which masks the size of the tumor present.

Size and extent of subglottic involvement have been difficult to appraise even with a mobile or somewhat paretic cord. Tumors of the transglottic group that have involved the false and fixed true cord frequently obscured marked infraglottic extension. In addition the base of the epiglottis has been sometimes overlooked. In all of these situations, the laryngograms have proved their value by precise localization and sharp delineation of the lower extent of the tumor.

Tumor crossing the midline was correctly determined by laryngogram with every lesion in the supraglottic, infraglottic and transglottic groups.

There was a high accuracy index for pyriform sinus lesions from the clinical and radiological standpoint. The majority of these cases required total laryngectomy and neck dissection, with modification such as skin grafting or other reconstructive procedures with larger tumors; however, there is a small number of selected cases where conservation of function procedures can be performed after a detailed clinical and radiological evaluation. This should help the surgeon decide what surgical procedures can be instituted.

No one can appreciate more than the surgeon the great importance of knowing where the lesion exactly is. He can plan his surgical procedure rather than complicate this with an ill-planned exploratory approach.

Size of tumor can be accurately determined for all classification sites with a mean variation from $\pm$0.3-0.6 cm. depending upon tumor site. It is impossible to estimate size by laryngoscopy, but it should not be surprising how frequently exact actual tumor size correlates with laryngograms. Size of tumor, degree of differentiation and location of the lesion have a direct bearing on the metastatic rate.

Since the transglottic group has the highest metastatic rate for apparent and inapparent metastases when the tumor is over 2 cms. in diameter, it follows that neck dissection with total laryngectomy is mandatory in this situation. If a palpable node is present on one side with a 2 cm. or larger trans-

glottic or supraglottic lesion, consideration of bilateral neck dissection is warranted.

It should be apparent that there are other therapeutic implications. Patients with small glottic cancer and possibly minimal lesions of the epiglottis where the metastatic rate is low might better be handled by irradiation. With improved methods of treatment by radiotherapists, conservation of function will apply to radiotherapy and the parameter of surgical treatment will be better defined. Until the time when this study is again reviewed and specific conclusions drawn, the surgical management will continue to be selected on the basis of accurate clinical and radiologic diagnosis.

SUMMARY AND CONCLUSIONS.

1. Accurate clinical classification of cancer of the larynx is necessary since the choice of therapy is governed by the probability and location of metastases.

2. Analysis of data obtained from a study on routine *en bloc* neck dissection with total or subtotal laryngectomy has given us very valuable information as to certain characteristics of the primary lesion.

3. A pathologic classification based on location of the primary lesion has been used for laryngographic and clinical use. The value of the proposed classification indicates that there is a progressive increase in metastatic rate from glottic, infraglottic and transglottic cancers.

4. Size of tumor, degree of differentiation, and location is related to apparent and inapparent cervical metastases.

5. Laryngograms can more accurately localize and objectively document the size of the cancer than clinical evaluation.

6. Size of the primary tumor can be estimated on laryngograms to within $\pm$0.3-0.6 cm. of actual tumor size.

7. The laryngogram is necessary for accurate diagnosis.

8. Logical treatment will necessarily follow. *a.* Conservation of function by radiotherapy for early lesions of the cord,

b. larynx-sparing operations for selected cases of supraglottic or pyriform sinus lesions, *c.* more radical operations (total laryngectomy to include neck dissection when the inapparent metastatic rate is high.

9. The therapeutic conclusions drawn from this study are necessarily tentative. The decision test by which all therapy is judged is a careful follow-up of patient survival.

BIBLIOGRAPHY.

1. Leborgne, F. E.: Classification of Carcinoma of the Larynx. The Laryngoscope, 63:1089-1095, 1953.

2. Lindsay, J. R., and Ironside, W. M. S.: Carcinoma of the Larynx. Classification and Results of Treatment. The Laryngoscope, 65:1117-1128, 1955.

3. Bacless, F., and Denoix, D. F.: Presentation d'un project de Classification clinique des Tumeures malignes du Larynx. *Jour. de Radio. et d'Electrol*, 38:187-193, 1957.

4. Pietrantoni, L., and Fior, R.: Clinical and Surgical Problems of Cancer of the Larynx and Hypopharynx. *Acta Oto-Laryngol.*, Supp. 142, 1958.

5. Pietrantoni, L.: Il Problema Chiruirgica della Metastasi Linfoghiandolari Cervicali del Cancers della Laringe. *Arch. Ital. Otol.*, Supp. 14, 64:1-37, 1953.

6. Le Roux-Robert, J.: Le Chie Seule et l'ass. Chir Radioth. du Trait du Canc. du Larynx. *Bull. du Canc.*, Paris, 35:365, 1948.

7. Le Roux-Robert, J.: Classification and Statistical Study of Cancer of the Larynx. *Ann. Otol.*, Paris, 76(6):395-399, June, 1957.

8. Seventh International Congress of Radiology, Copenhagen. *Acta Radiol.*, Supp. 116, 1954.

9. International Union Against Cancer: "Clinical Stage Classification of Malignant Tumors of the Larynx" (1956 draft), Vol. 25. Rue d'Ulm, Paris, Ve.

10. Ogura, J. H.: Classification and Staging of Cancer of the Larynx. VI Congresso Pan-Americano De Otorrinolaringologia E Bronchoesofagologia e da VII Reuniao da Federacao Brasileira das Sociedades de Otorrinolaringologia e Broncoesofagologia, Rio de Janeiro, August 10-17, pp. 435-443, 1958.

11. Ogura, J. H.: Surgical Pathology of Cancer of the Larynx. The Laryngoscope, 65:867-926, Oct., 1955.

12. McGavran, M. H.; Bauer, W. C., and Ogura, J. H.: The Incidence of Cervical Lymph Node Metastases from Epidermoid Carcinoma of the Larynx and Their Relationship to Certain Characteristics of the Primary Tumor. A Study Based on the Clinical and Pathological Findings in 96 Patients Treated by Primary *en bloc* Laryngectomy and Radical Neck Dissection. To be published in *Cancer.*

13. Powers, W. E.; McGee, H., and Seaman, W. B.: Contrast Examination of Larynx and Pharynx. *Radiology*, 68:169-177, Feb., 1957.

14. Ogura, J. H.: Supraglottic Subtotal Laryngectomy and Radical

Neck Dissection for Carcinoma of the Epiglottis. THE LARYNGOSCOPE, 68:983-1003, June, 1958.

15. OGURA, J. F.: Cancer of the Larynx, Pharynx and Upper Cervical Esophagus. Five-Year Results of Laryngectomy and Radical Neck Dissection for Laryngeal Cancers. Presented at the A.M.A. Section on Otorhinolaryngology, June, 1959. To be published in *Arch. Otolaryngol.*

DISTINGUISHED SERVICE AWARD GIVEN TO NEARLY DEAF EAR PHYSICIAN.

Dr. Kenneth M. Day of Pittsburgh, Pa., is recognized by his medical colleagues as one of the most successful ear physicians in the country.

He attributes his success to the fact that he has been nearly deaf himself for many years, and has served as a model of what the hearing handicapped can really do.

In honor of his service to medicine and mankind, Dr. Day received a distinguished service award May 20, 1960, from the Pennsylvania and New Jersey Academies of Ophthalmology and Otolaryngology at a joint annual meeting in Atlantic City, N. J., attended by eye, ear, nose and throat physicians from six middle Atlantic states.

THE APPLICATION OF IN VITRO CYTOTOXIC REACTIONS TO CLINICAL DIAGNOSIS OF FOOD ALLERGY.*

WM. T. K. BRYAN, M.D.,
and
MARIAN P. BRYAN, B.A.,
St. Louis, Mo.

The need for improved diagnosis of food allergy is widely recognized. The paper by Black[3] in 1956, strongly suggested the use of viability of leucocytes as a sign of allergic reaction. His observations dealt with the behavior of living leucocytes in the simultaneous presence of both allergen and plasma from a sensitized individual. If specific antibodies to the allergen were present, the polymorphonuclear leucocytes showed toxic reactions with death of the cell occurring within 15 minutes to several hours. If the reaction was prompt and strong, clinical sensitivity to the allergen was suspected. Glaser[7] and co-workers attempted to evaluate the test in 1958. They reported 186 tests on 13 patients with 27 known sensitizations. They questioned the validity of the test since it revealed reaction to only one allergen in 24 "tested," but 19 had poor controls, and no interpretation could be made. The application of Black's cytotoxic test with minor variations to 107 patients with wide variety of possible or definite allergies to food, forms the basis of this report.

The destruction of leucocytes by the antigen-antibody reaction has been observed for many years from several points of view. As early as 1909 Achard and Bernard[1] studied specific reactions of leucocytes. In 1947 Squier and Lee[13] reported a maximum fall of 43 per cent in leucocytes during *in vitro* reactions of untreated ragweed sensitive blood with ragweed extract. Attempts to use this for quantitative measurements

*Read at the meeting of the Middle Section, American Laryngological, Rhinological and Otological Society, Inc., Chicago, Ill., Jan. 17-18, 1960.
Editor's Note: This manuscript received in The Laryngoscope Office and accepted for publication Jan. 22, 1960.

of the strength of house dust extracts were made by Berkowitz and Scherago[3] with only partial success. Franklin and Lowell[9] in 1949, failed to find destruction of leucocytes from ragweed patients, using a total count method. Tuberculin was shown to cause a similar fall in lymphocytes separated from plasma by Favour.[8] A preliminary report from Finland (Pettay[11]) estimated leucocytolysis *in vitro* caused by different allergen extracts. Extracts giving three plus skin reactions caused a 23 per cent drop in the total leucocyte counts, two plus reactions gave a 17 per cent drop and weak reactions a 13 per cent drop. Negative extracts caused no decrease. Waksman[15] reported specific white cell lysis produced by the combination of rabbit antiserum to a principal protein (ovalbumin, bovine gamma globulin) with homologous antigen. Hartman and Hock[10] observed in careful animal experiments that the same cytological changes were observed in blood from both sensitive and non-sensitive animals but that the manifestations of leucocytic injury were greater in blood from sensitive animals, which indicated that injury to blood leucocytes can result from an antigen-antibody reaction. A scholarly review of available literature on the toxic effect of the antigen-antibody reactions on cells of hypersensitive reactors is given by Waksman[16] in "Cellular and Humoral Aspects of the Hypersensitive States." It is thus evident from the literature that the antigen-antibody reaction does give a leucocytotoxic effect. Vaughan[14] used the post-prandial fall in the leucocyte count as a sign of food allergy, and Rinkel[12] incorporated this into his method for testing foods (Chap. VII).

The technique for observing the leucocytic toxic reaction, as described by Black, is simple in plan but rather difficult to carry out; fortunately, however, with experience it becomes easier and errors in technique less frequent.

The first problem is to obtain an abundance of viable leucocytes. For a year our sporadic efforts were not consistently successful. Now we take from 5 to 10 cc. of blood, add 0.07 cc. of transfusion citrate per cc. of blood, and centrifuge in small glass tubing for at least one hour at medium speed. The tubing is pulled slightly in the middle to narrow

the center part of the tubes so that the buffy coat will be elongated and thereby easier to remove (see Fig. 1). With this technique the resulting buffy coat is usually adequate. The use of capillary tubing requires a meticulous technique which proved not only to entail more work but also to be more apt to induce error. It is now reserved for cases in which veni-puncture is not practical.

After the buffy coat is obtained about two-thirds of the

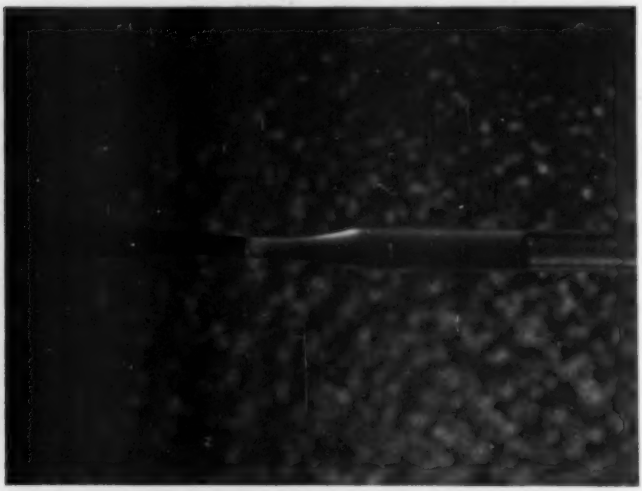


Fig. 1. Glass tubing with narrow middle portion in which citrated blood has been centrifuged to obtain buffy coat and serum.

serum is removed by an appropriate capillary pipette; then the buffy coat is withdrawn and mixed with the serum so that there will be between 15 and 40 leucocytes per high power field.

Special care is necessary in mixing the leucocytes and serum. This is accomplished by drawing the mixture back and forth in the tube, stirring and rotating it five or more times. A slide with concave depressions such as is used for blood agglutination work provides satisfactory mixing chambers.

Since the cells settle rapidly, the mixing must be done just before the cells are put on the slides to insure even distribution in all the samplings. In order to avoid drying, the mixture can be saved for long intervals in the tube, but before putting out further tests it must be thoroughly mixed.

The antigens used were dry extracts of foods from Hollister-Stier. Solutions of 0.1 per cent were made with pyrogen-free

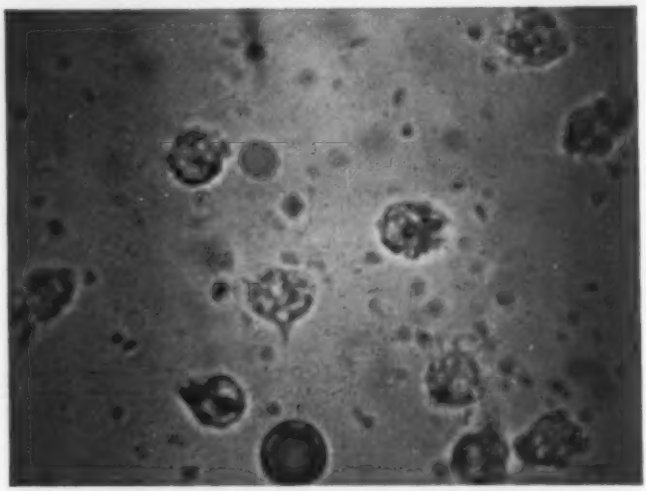


Fig. 2. Normal leucocytes with pseudopods.

distilled water and allowed to stand for 24 hours. The solutions were dropped on numbered slides (three to a slide) so that the resulting area of dried food would be slightly larger than the cover slip. This preparation of the food deviated slightly from Black's method which was to take a barely visible amount of dried protein allergen picked up with the small end of a fresh flat toothpick and to add the powder to a drop of distilled water on the slide. It seemed advisable to use known dilutions of the antigen to control the quantities and obtain more nearly uniform concentrations of food. With this

method large numbers of uniform slides easily can be prepared in advance.

It is well to prepare all the glass used in the test with "Silicad," which is a silicone product. With its use the controls recently have remained good for over an hour, and one was observed for 11 hours. This is practically a prerequisite for performing the test.

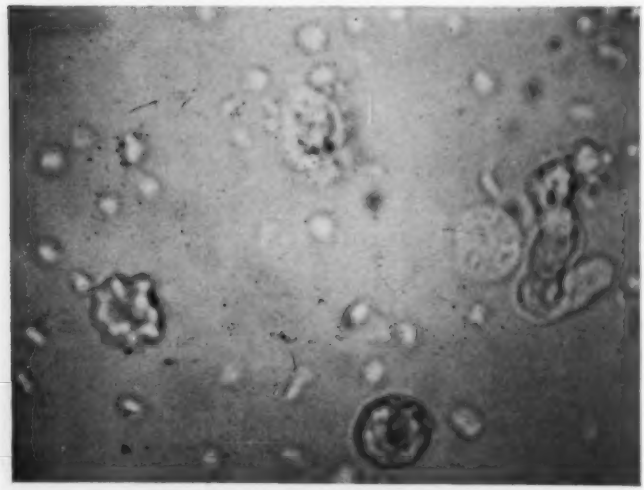


Fig. 3. Normal active leucocytes showing shape variations. Note platelets.

The leucocytes are easily visible under a good high-dry objective. We find the 60x apochromatic objective satisfactory, making the use of oil-immersion unnecessary. The neutrophils are irregular in shape due to their numerous pseudopods (see Figs. 2 and 3). With close observation they show streaming of granules and change of shape with amoeboid-like motion. Eosinophiles are easily identified by the large refractile granules. They are much less motile than the neutrophils. The lymphocytes show very little visible change in cell contour or movement.

Cell counts, as Black recommended, have not been done, but usually about 12 different fields of cells are studied. When the distribution of cells is good, each field contains between 15 and 40 leucocytes. After a little experience the healthy, viable condition of the leucocytes is very clear. The deviations from the normal, however, require careful observation and experience with judging cells in the fresh unstained condition. The slides are observed within ten minutes after they are made. A second examination is made after 30 or

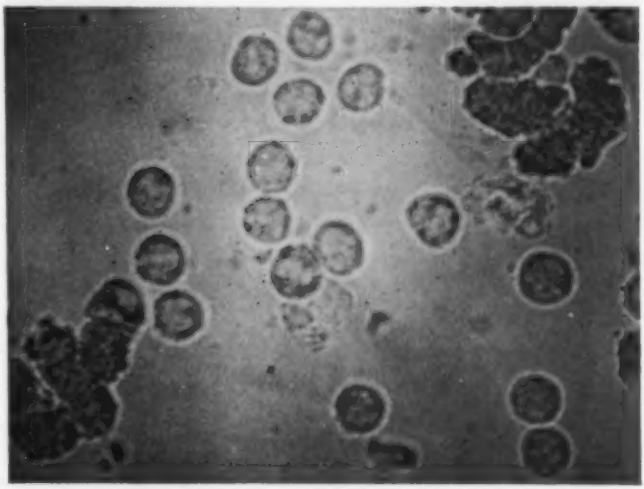


Fig. 4. Round leucocytes indicating reaction to food allergen.

40 minutes. Sometimes, when the second examination was questionable, a third has been made at the end of an hour.

The reactions of the neutrophils, as we have seen them, present the following changes:

1. Loss of amoeboid movement and cessation of streaming of cytoplasmic granules.

2. Rounding of the cell contour with or without small spine-like projections (see Fig. 4).

3. Vacuolization and spreading of the cytoplasm. The cell may become thin and flat (see Fig. 5).

4. Fragmentation of the cell with rupture of the membrane and dispersion of the granules (see Fig. 6).

Frequently, in the immediate marked reactions, not mentioned by Black, the cells begin to disintegrate before they can be observed. Along with the disintegration of the neutro-

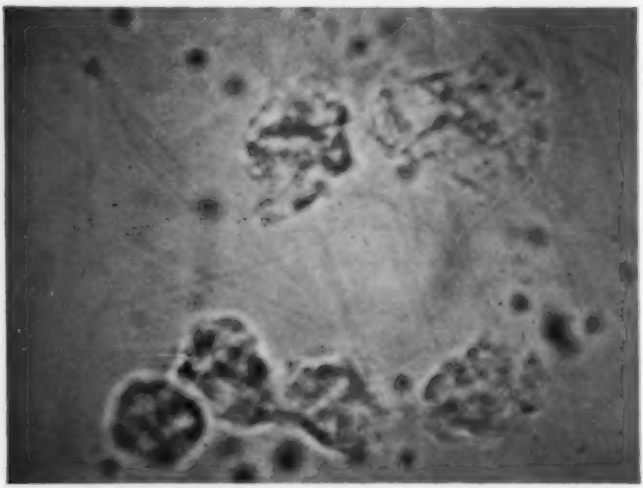


Fig. 5. Beginning disintegration of leucocytes—reaction to food allergen was marked.

phils there is also a rapid clumping, agglutination and disappearance of the platelets. The red blood cells agglutinate and appear to be mushy, with loss of distinct limiting cellular membranes. In slightly less severe reactions, the red cells are crenated (see Fig. 7). The eosinophiles may remain intact after the other cells are gone; thus they seem to be more resistant to the toxic effects than are the neutrophils. The lymphocytes are also somewhat resistant, similar to the eosinophiles; however, in severe reactions they, too, are difficult to find, so it is suggested that they also share to some extent in

the cytotoxic reaction. (Favour[7] noted that the lymphocytes were the first affected in the reaction of tuberculin on cells without serum.)

In our experience it is not necessary to incubate the cells at 37° C. to observe reactions; however, the room in which we work was warm (80 to 85° F.). For the most part the tests were not observed after 45 minutes to one hour.

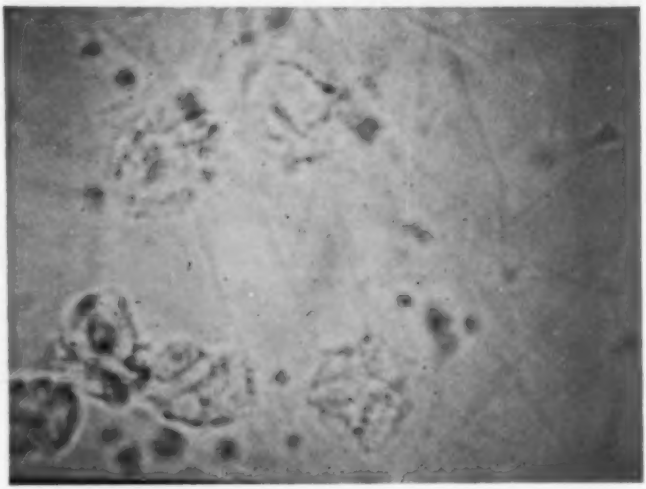


Fig. 6. Complete disintegration of several leucocytes in the presence of offending allergen.

The reactions of these tests have been evaluated in terms of marked, moderate, slight and negative. A total of 3,828 reactions were studied, which were divided according to severity as shown in Table I and as follows:

Marked—466—majority of leucocytes disintegrated, platelets diminished, and red cell reactions, of which 95 had occurred by the first observation (called immediate marked, M-1) and 371 by the second (M-2).

Moderate—522—all leucocytes round with only a few disintegrating.

Slight—533—approximately half of the leucocytes round and half active in ten to 15 fields examined.

Negative—2,307—viable normal appearing neutrophils and platelets in all fields examined. A comparison of these with the positive reactions often formed the basis of the diagnosis of

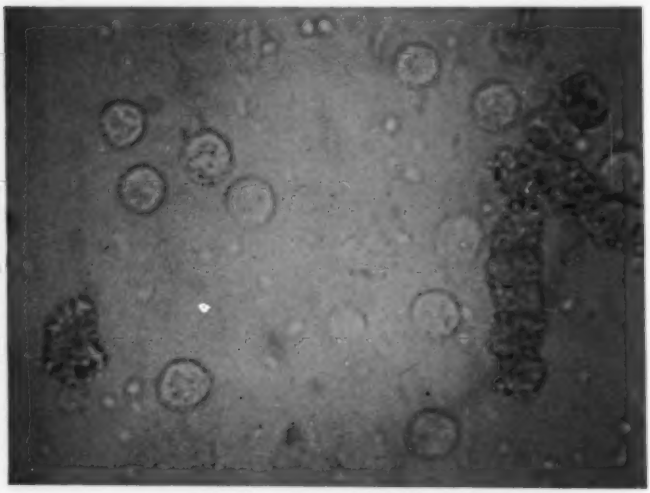


Fig. 7. Round leucocytes and crenated red blood cells.

negative, because the controls, until recently, showed more rapid deterioration of the cells than did those with compatible food. A remarkable improvement of the controls followed the use of Silicad on slides and cover slips.

A few in which definite judgment was difficult were classified as questionable.

Two-hundred-thirty-two individual food tests were repeated. When compared, we found 124 correlated exactly; 66 varied only one degree (as from slight to moderate or

TABLE I.

Reactions to Allergens.

Allergen	M-1	M-2	Mod.	Sl.	Neg.	Total	Allergen	M-1	M-2	Mod.	Sl.	Neg.	Total
Corn	3	16	31	22	62	134	Rice	–	5	8	4	37	54
Wheat	3	18	29	19	65	135	Brazil Nut	1	5	7	4	32	49
Egg	3	15	29	24	72	143	Cashew	1	–	11	2	38	52
Milk	3	17	21	27	63	131	Cocoanut	–	2	2	8	39	51
Beef	2	11	21	18	61	113	Peanut	1	3	4	10	34	52
Pork	–	8	13	23	78	122	Pecan	–	–	2	4	35	41
Lettuce	5	11	22	27	47	112	Black Walnut	–	3	3	4	28	38
Potato	3	7	20	18	62	110	Cherry	–	3	2	2	28	35
Tomato	–	7	14	19	57	97	Grapefruit	–	3	4	1	26	34
Orange	–	4	11	17	58	90	Apple	2	2	2	1	30	37
Peach	1	2	10	23	49	85	Banana	2	9	2	4	16	33
Strawberry	1	4	5	19	56	85	Pear	–	–	1	1	30	32
Cocoa	4	7	12	12	51	86	Asparagus	–	–	1	2	26	29
Malt	11	31	20	7	19	88	Beet	–	1	–	1	29	31
Yeast	10	18	15	9	34	87	Cabbage	–	–	–	2	24	26
Soybean	1	3	10	19	55	88	Cauliflower	–	–	–	6	22	28
Coffee	4	6	11	12	41	74	Sweet Potato	3	6	6	4	12	31
Garlic	4	9	13	8	36	70	Turnip	–	6	3	3	14	26
Onion	3	22	13	11	21	70	Black-eyed Peas	–	–	–	2	18	20
Pepper	2	1	13	7	48	71	Broccoli	–	–	–	2	18	20
Chicken	1	8	16	10	36	71	Carrot	–	–	1	1	19	21
Tuna	1	7	11	10	47	76	Cucumber	–	–	1	1	15	17
Celery	1	8	4	6	14	33	Mushroom	1	–	4	2	11	18
Lima Bean	–	–	–	1	29	30	Squash	–	–	–	1	10	11
Pea	1	8	1	2	19	31	Olive	–	1	2	2	4	9
String Bean	1	6	3	2	21	33	Tea	–	1	2	3	7	13
Pineapple	1	–	3	3	28	35	Apricot	–	1	–	2	4	7
Cantaloupe	–	6	6	6	21	38	Blackberry	–	3	1	1	3	8
Honey Dew	–	1	5	3	30	39	Blueberry	–	1	–	–	6	7
Turkey	–	3	7	10	52	72	Date	–	–	2	–	5	7
Shrimp	2	3	9	5	50	69	Fig	–	–	–	1	5	6
Lamb	1	12	4	6	34	57	Grape	–	–	1	1	4	6
Goat Milk	3	9	5	3	37	57	Lemon	–	–	1	–	4	5
Oat	1	8	7	6	36	58	Plum	–	2	–	–	3	5

normal, or marked to moderate); 34, two points of discrepancy; seven had three points; one, four (see Table II).

These errors are partly unexplained and some may be due to faults in technique. Extreme cleanliness of all glassware is essential, and as mentioned above, the use of Silicad on both slides and cover slips should decrease errors in the future. Variability in drying due to different thickness of the size of drops of the cell suspension may be avoided by sealing the cover slip with vaseline. Any break in meticulous cleanliness may introduce a noxious substance. Pyrogens (bacterial products that cause fever) may be found in ordinary distilled

TABLE II.

Total Tests Repeated on Same Day—232.

Number Agreed	124—53%
Number Disagreed—	
Slightly	66—28%
Definitely	42—18%

water. Experiments are being made to determine the optimal quantities of the antigens.

The selection of patients for the cytotoxic tests is often facilitated by the cytologic findings. In previous papers the authors[6] showed a correlation between increased numbers of mast cells and allergy to food. This finding frequently gives a clue to the existence of food allergy. Of the 47 patients of this series who had nasal cytology, 30 had mast cells. Fifteen of those with mast cells were in the group having chronic rhinitis. Thirteen of these correlated with their cytotoxic food tests. One had only a slight improvement, and one did not correlate. It seems that nasal cytology should be done when possible.

Patients were also selected in whom the diagnosis was obscure and symptoms were of long duration, based upon the hypothesis that allergy might be the undiscovered etiology of otherwise undiagnosed diseases. The various symptoms or conditions studied are given in Table III. These number 133 and were gathered from the 107 patients tested. It is seen

that the symptoms of known allergic etiology improved with allergic measures, as did some others of questionable allergic etiology. In the group of Ménière's disease, four of the six patients were shown to have allergy to food. Two of them appear to be "cured."

The results of a test are told to the patient verbally and in writing. The patient is advised to discontinue all foods that

TABLE III.

Symptoms and Syndromes Studied.

	Totals	Improved	Sl.	Unimp.	Unknown
Chronic Rhinitis, Sinusitis	36	20	7	7	2
Headache	21	15	2	3	1
G-I	13	10	1		2
Asthma and Cough	13	2	4	2	5
Infections, acute	7	5	2		
Angioneurotic Edema, Urticaria, Dermatitis	7	6	1		
Conjunctivitis and Palpebral Edema	7	6	1		
Ménière's	6	2	2	2	
Migraine	5	3	1	1	
Polyps	5	2	2		1
Myalgia	4	2	1	1	
Fatigue	4	2		1	1
Serous Otitis	2	2			
Hoarseness	1	1			
Iritis	1	1			
Arthritis (gout)	1	1			
	133	80	24	17	12

gave marked or moderate reaction, but to reintroduce the foods, one at a time, beginning with lunch on the fifth day. This has rarely been carried out completely, for many patients have either felt so much better from the diet that they were not interested in eating the food again, or lost interest due to the severity of the advised change of diet. The patients are advised to watch for the "slight reactors" and to observe other possible reactions.

DISCUSSION.

The Black test has proved useful in many cases. There are apparently false positive reactions and some errors. There

are some cases in which the symptoms have not been due to the food allergy, whereas others with nasal symptoms relieved were surprised that other seemingly unrelated symptoms were also improved.

Ménière's disease has been difficult to cure. Occasionally it has been known to respond to non-specific allergic medication, and a few cases have been reported to be due to food allergy. By means of much more efficient food testing possible with this test, it may be possible to diagnose the food factors in many more cases.

Another unique value is the diagnosis of allergy to many foods both in severe and in very mild cases. In both of these groups the introduction or omission of a single food may cause no change in symptoms, since the severe cases have maximal severity from the other foods, and the mild cases may notice symptoms only when several allergens are present.

The test is perfectly safe for the patient since no antigen is administered.

The actual accuracy of the test is yet to be determined. The key of the test, the leucocyte, is a very delicate structure influenced by minor changes in environment.

If the tests are not given a preliminary observation before incubation certain irregularities sometimes occurring in distribution of the cells may be mistaken later for the disappearance of cells, and the immediate marked reactions would be missed.

The degree of reaction apparently can be influenced by the amount of antigen used in the test. It may also be influenced if the test is made during a food reaction. Blood taken during the time of a reaction has been found to be non-reactive to the allergen, whereas blood taken the day before or the day after (one observation) gave strong reactions.

The more efficient diagnosis of food allergy offered by cytotoxic tests makes it possible to determine allergy to food in cases that otherwise could not or would not submit to long dietary experimentation.

SUMMARY.

The cytotoxic food allergy test, originally described by Black has been used in 107 patients whose ages varied from nine to 80 years. They had a wide variety of possible or definite allergies to food. The technique used varied only slightly from the method first reported. This test, while time consuming and requiring a cytologist for accurate interpretations of the cellular variations, has proved reliable to a degree that it may be employed in selected cases as a diagnostic method in which food allergy is a possibility. The presence of mast cells in nasal secretions is often a useful indicator of food allergy with nasal pathology and may suggest the advisability of doing the leucocytoxic test.

BIBLIOGRAPHY.

1. Achard, C., and Bernard, H.: Reactions Specifiques de Leucocytes. *Leucodiagnostic Mem. Soc. Biol.*, 2:502-503, 1909.

2. Berkowitz, Bernard, and Scherago, M.: Standardization of Dust Extract. *Ann. Allergy*, 8:(4)453-467, July-Aug., 1950.

3. Black, Arthur P.: A New Diagnostic Method in Allergic Disease. *Pediatrics*, 17:(5), May, 1956.

4. Bryan, W. T. K., and Bryan, M. P.: Significance of Mast Cells in Nasal Secretions. *Trans. Amer. Acad. Ophthal. and Otolaryngol.*, 63:(5) 613-627, Sept.-Oct., 1959.

5. Bryan, W. T. K., and Bryan, M. P.: Cytology in Otolaryngology. *Trans. Amer. Acad. Ophthal. and Otolaryngol.*, 63:(5)597-612, Sept.-Oct., 1959.

6. Chambers, van Vleck; Hudson, Bruce H., and Glaser, Jerome: A Study of the Reactions of Human Polymorphonuclear Leukocytes to Various Allergens. *Jour. Allergy*, 29.

7. Favour, C. B.; Smith, Fremont, and Miller, J. M.: Factors Affecting the *in vitro* Cytolysis of White Blood Cells. *Amer. Rev. Tuberc.*, 60:212-222, 1949.

8. Favour, C. B.: Lytic Effect of Bacterial Products in Lymphocytes of Tuberculous Animals. *Proc. Soc. Exper. Biol. and Med.*, 65:269-272, 1947.

9. Franklin, W., and Lowell, F. C.: Failure of Ragweed Pollen Extract to Destroy White Cells from Ragweed Sensitive Patients. *Jour. Allergy*, 20:375, 1949.

10. Hartman, John D., and Hock, Willis S.: Changes in Blood Leucocytes Resulting from an Antigen-Antibody Reaction. *Amer. Jour. Physiol.*, 183:214-220, 1955.

11. Pettay, Ossi:, Preliminary Report on the Use of *in vitro* Leukocytolysis as a Test in Allergy. *Scand. Jour. Clin. and Lab. Invest.*, 4:77, 1952.

12. Rinkel, Herbert J.; Randolph, Theron G., and Zeller, Michael: "Food Allergy." Charles E. Thomas, Springfield, Ill.

13. Squier, T. L., and Lee, H. J.: Lysis *in vitro* of Sensitized Leucocytes by Ragweed Antigen. *Jour. Allergy*, 18:156-163, 1947.

14. Vaughan, W. T.: The Leucopenic Index as a Diagnostic Method in the Study of Food Allergy. *Jour. Lab. and Clin. Med.*, 21:1278-1288, 1935-1936.

15. Waksman, Byron H.: Specific White Cell Lysis Produced by Combination of Rabbit Antiserum to Purified Protein (Ovalbumin, Bovine Gamma Globulin) with Homologous Antigen. The Role of Non-precipitating Antibody. *Jour. Immunol.*, 70:331-344, 1953.

16. Waksman, B. H.: "Cellular and Humoral Aspects of the Hypersensitive States." A Symposium Held at the New York Academy of Medicine. Edited by Sherman Lawrence, M.D. Hoeber-Harper, 1959.

TEMPLE UNIVERSITY SCHOOL OF MEDICINE AND HOSPITAL.

Postgraduate Course in Laryngology and Laryngeal Surgery, September 26th-October 7th, 1960, and April 10th-21st, 1961.

Postgraduate Course in Bronchoesophagology, November 7th-18th, 1960, and February 6th-17th 1961.

These courses are to be given in the Department of Laryngology and Bronchoesophagology, Temple University Medical Center, under the direction of Drs. Chevalier Jackson and Charles M. Norris.

The tuition fee for each course is $250. Application and further information may be obtained by writing to Jackson-Research, Temple University Medical School, 3400 N. Broad St., Philadelphia 40, Pa.

PSEUDO NEURAL HYPACUSIS IN CHILDREN.*

SEYMOUR J. BROCKMAN, M.D.,†
and
GLORIA H. HOVERSTEN, M.A.,‡
(By Invitation),
Los Angeles, Calif.

Since World War II there has been an increased interest and awareness in factors of and problems related to hearing difficulties. Initially, this interest was directed toward problems of diagnosis, treatment and rehabilitation of organic hearing losses.

As facilities, techniques and consultants became more adept and facile in the various otologic centers established by the armed forces, more knowledge was acquired of organic difficulties and also of functional components as factors in hearing loss. Several studies (Johnson, Work and McCoy,[1] Truex[2]) have shown that as many as 40 per cent of the members of the armed forces evaluated for hearing difficulties had a part or most of their hearing disability secondary to functional rather than organic causes.

The armed forces' centers and, after the war, the veterans' centers, using a team approach of the otologist, psychiatrist or psychologist, and the audiologist were able to establish more definite criteria for such evaluations. An excellent article on just such problems was presented by Truex[2] with regard to findings at the Deshon Center during and after the war.

With the end of the war, much of this work was published

*Read at the meeting of the Western Section, American Laryngological, Rhinological and Otological Society, Inc., Denver, Colo., Jan. 22, 1960.

†From the Department of Otolaryngology, University of Southern California School of Medicine; Cedars of Lebanon Hospital, Los Angeles; and Children's Hospital, Los Angeles.

‡Audiologist in practice with Drs. Victor Goodhill, Seymour J. Brockman and Irwin Harris, Los Angeles.

Editor's Note: This manuscript received in The Laryngoscope Office and accepted for publication Feb. 25, 1960.

and was used as a guide in the diagnosis of such problems as they were presented to the private physician.

The problems of functional hearing loss encountered in the armed forces as compared to those encountered in private practice are different in some respects. In the armed forces' and veterans' centers, a good number of the cases were true psychogenic hearing losses due to battle trauma. A smaller portion was judged to be malingering, either for benefit of non-return to duty, pension or transfer. In private practice, more of these losses in adults are due to medico-legal problems following accidents and are placed in the category of malingering rather than true psychogenic hearing loss. The physician in private practice is aware of this, and if he does not have the facilities for testing will usually refer the patient for more complete diagnostic evaluation. Practically all of this work has been done on adults.

The otologist with some pediatric-otologic practice, having become cognizant of functional problems as encountered in adults, has encountered similar problems in children.

The child's problem is different from that faced in adults. Whereas adults with functional loss are attempting in many instances to shirk a duty or exact a monetary gain, no such problems exist in children. The parents are not usually aware of the hearing problem until the school brings it to their attention; in fact, it may be due to the expansion of the excellent testing programs in schools that these problems, which we are sure previously existed, are now coming to our attention.

In our practice, we have had occasion to see a number of these children and have perused the literature for comments considering the frequency of this problem. There has been a dearth of material on the subject. The most recent complete report has been published by Dixon and Newby.[3] Juers[4] and Myklebust[5] have been the other main contributors.

DESCRIPTION OF SUBJECTS.

We have selected nine of our more recent cases for discus-

sion. These children ranged in age from eight to 15 years; six were female, three were male. In all nine of the cases, referral to our office was brought about by a school hearing test showing the hearing to be impaired. Prior to the school test, there had been no awareness or concern on the part of the parents or child as to the presence of a loss.

In none of the cases were behavior problems, academic difficulties or speech problems relayed as a complaint by the parent on initial examination. None of the children was observed to have other than excellent conversational ability. All had normal speech.

The following criteria were used in the initial determination of the possibility of a functional component or completely functional hearing problem necessitating audiologic study:

1. Discrepancy between the voluntarily obtained speech reception threshold and the average loss for pure-tones in the speech range (500-2000 cps).

2. Inconsistency in conversational ability outside of the test situation as compared with the pure-tone audiometry test results.

3. Pure-tone threshold responses inconsistent and variable.

TESTING PROCEDURES.

In our practice, pure-tone audiometry generally precedes speech audiometry except in the case of children five years or under. With the children under discussion, it has not been possible to establish any single uniform set of procedures, the audiologist preferring to introduce various tests dependent upon the child's previous responses; however, we find that a few generalizations as to test procedure have emerged as a result of these experiences.

1. Speech Audiometry:

Since it has been our observation that the speech reception threshold usually is much closer to the true hearing level than the pure-tone audiogram, the audiologist begins with speech audiometry, simply continuing informally in the sound-

field through the speaker, the conversation which was originally started in the same room with the patient. The child is given the impression that testing has not begun.

For example, he may be told that the audiologist is simply getting ready for the test and needs to know the answers to such questions as, "How do you spell your last name?" and "How old are you?" To add to the child's impression that testing has not begun, the light in the control room which enables the audiologist to be seen can be left on (even though the patient is not given the opportunity to lip-read).

The level at which this conversation and questioning is performed is dependent upon the observed ability to follow conversational speech prior to testing. If this appears normal, as it has in all our cases, conversation is then presented at soft levels of 15 to 25 db. Care should be taken not to begin with intensities much greater, as the child will use this as his base-reference, and it will be much more difficult to secure responses at the soft levels which may have been achieved much more easily initially.

Continuing at the same intensity level of 15 to 25 db, the child is simply told, "Now I want you to repeat some words." Spondaic words may then be presented and the speech reception threshold obtained. After testing several of these children, the technique evolved of omitting the speech reception threshold and instead, going directly to the speech discrimination tests. A PB word-list is given at the same level at which the audiologist and child carried on conversation thus leading the child to respond unsuspectingly at this level. Note that no intensity decrease has taken place and, therefore, the impression of "testing" is minimized.

Six children gave normal discrimination scores (90 to 100 per cent) at levels of no greater than 30 db. It was possible to assume from this that the actual speech reception thresholds for these children were considerably better than their admitted speech reception thresholds measured following the speech discrimination tests.

Three of the children apparently made deliberate errors,

their discrimination scores showing wide variability. For example, one child scored 32 per cent at 40 db and on another word-list given two days later scored 72 per cent at the softer level of 25 db.

In all of our cases, informal conversation was carried out without difficulty at a better level than the admitted measured speech reception threshold. In the nine children, initial speech reception thresholds were obtained of 10 to 25 db.

At this point, the audiologist has objective evidence that the child's hearing is certainly near-normal and that he is probably under no strain in ordinary listening situations. Speech audiometry, using a similar presentation, can then be continued with earphones.

2. Pure-Tone Audiometry:

Pure-tone audiometry is attempted in the standard manner. Presentation of tones and method of determination of thresholds will vary from child to child. As a general rule, we think it advisable again to *expect* the response at softer intensity levels so that the child is not given a loud tone as a base-reference. Only when all efforts are exhausted at getting a pure-tone response at these levels (approximately 30 db or below) should the audiologist present tones at louder intensity levels. We think much of the error on school tests may have been simply in "cranking" up the sound to high levels until the child responded.

The pure-tone testing is introduced with some such casual remark as, "You will have no trouble hearing these tones; they are easy to hear." A tone is then presented at 25 to 30 db and, if the child does not respond, the audiologist's attitude is one of surprise. The audiologist may suggest to the child that he hears the tones and that he simply did not understand the directions. Often a child can be coaxed into a response in this manner. Sometimes the ascending threshold, starting with minus 10 db and interspersing coaxing, can result in a nearer true threshold response. If such coaxing fails at these levels, it becomes necessary to present tones of higher intensity.

Factors which should be noted during this pure-tone testing are:

1. Variability of "threshold" responses for a single tone. These frequently cover as wide a range as 30 to 35 db and can be influenced by the method of presentation, varying the frequency and/or loudness-contrast of tones.

2. Comparison of the ascending threshold and the descending threshold as proposed by Dean A. Harris.[6] Harris states that, in the adult malingerer, a difference of 10 db or greater between the ascending and descending thresholds is highly indicative of non-organic involvement.

3. Reaction to surprise directions interspersed throughout the pure-tone test. For example, one child was moving the earphone cords while making no response to pure-tones at 55 to 60 db. A sharp rebuke, "Don't do that!" at 25 db caused the child to drop the earphone cords immediately. Several children raised their hands to the earphones to remove them when told, "We're finished. You can take the earphones off" at levels at which they had not responded to spondees or informal conversation.

It is helpful for the younger child, eight to nine years, whose loss seems to be on more of an unconscious basis, an "inability to listen," rather than a willful malingering, to be given the opportunity to respond to play-audiometry. Frequently, this simple concretizing of the abstract listening activity (by dropping a marble in a box or putting a peg into a hole when the tone is heard) enables this child to center his attention and thus respond at softer levels. We have one child eight years of age, whose threshold moved from 70 db to 5 db by changing to this simple method of testing usually reserved for children six years or under (see Fig. 1).

These children may do even better if they are trained and encouraged to respond to softer levels. We have a glass between the test and control room so that the child can see the audiologist. Initially, this visual situation is maintained, the audiologist nodding approval when the child questions or hesitates in response to a tone and sometimes indicating by

a gesture of "shh" or perhaps a finger gesture that the next tone will be very soft. When the child is able to go ahead on his own, then the light is dimmed so that the audiologist can't be seen, and the test continues.

In the child where these pure-tone and speech techniques do not result in formal establishment of normal hearing thresholds, it is sometimes necessary to resort to special tests such as the Stenger test for pure-tone, the modified Stenger for speech, the Doerfler-Stewart test and psychogalvanic skin resistance audiometry. These have proved most helpful.

PURE-TONE AVERAGE (500-2000 cps).

C.A., Age 10.		
June 18, 1959—		
No. 1	Air conduction—RE	40 db
No. 2	Air conduction—RE	30 db
No. 3	Air conduction—LE	20 db
No. 4	Air conduction—RE	10 db
No. 5	Bone conduction - LE	10 db
July 2, 1959—		
No. 1	Air conduction—RE	15 db
No. 2	Air conduction—RE	0 db
No. 3	Air conduction—LE	-10 db
No. 4	Air conduction—RE	-10 db

Fig. 1. Air conduction thresholds for the same ear of one child obtained on the same day by the same examiner using two methods.

DISCUSSION AND CASE REPORTS.

On initial otologic examination, two of the nine children had a transient otitis media which subsided rapidly on medical management. In no instance was the otitis media recurrent nor did it interfere with any of the subsequent test findings. We eventually were able to achieve both pure-tone and speech reception threshold results on all of the children indicating hearing within the normal range (15 db or less). Most commonly, the audiograms were of the perceptive type, bone-conduction and air-conduction being similar. If test results revealed an air-conduction loss greater than 60 db, the bone-conduction in these instances was superior. Five of the nine children (four females, 10 years of age or under, and one male, 14 years of age) were judged as having an inability to listen

similar to those described by Myklebust. Myklebust[5] discusses the fact that some children with otherwise normal hearing show poor conscious response to pure-tone stimulation. This he explains on the basis that the pure-tone is too abstract and meaningless to arouse cortical evidence and recognition on the part of the child. He further states that in the process of auditory maturation the child first shows evidence of response to speech or complex meaningful sounds or noise and that visible evidence of response to pure-tones is in some instances delayed. We concur with these statements. Some children respond to pure-tones at a much earlier age than others. This does not mean that the organ of Corti or the central pathways are not stimulated by a pure-tone, but merely that recognizable conscious evidence of response is delayed in development.

It is an accepted fact that some individuals will regress to infantile patterns psychologically in certain areas of their behavior when subjected to induced stress. Since the function of hearing to some extent represents a psychological reaction, it also is possible that some individuals are so sensitized or conditioned as to regress in the auditory area under certain situations of psychological stress. A greater loss in pure-tones in these cases would more logically be a regression than a suppression.

These five children appeared to be in need of training and encouragement in order to learn to respond to faint tones and speech. They did not reveal evidence of willful malingering but rather tended to be entirely cooperative and straightforward in the test situation. Further indication of the inability to listen and the advisability of training these responses to faint tones is illustrated by close examination of one child's audiograms (see Fig. 2).

With the exception of the 14-year-old male, four of these children apparently had made entirely satisfactory home and school adjustments, the parents having no complaints or anxieties. There were no gross emotional disturbances or speech problems apparent on visits to our office.

The remaining four of the nine children were strikingly

different in test behavior and histories from the five children just discussed. All four of these remaining children appeared to be willfully malingering, and on consultation, were found to be the source of considerable anxiety to their parents.

One of the four, an 11-year-old girl, had been in many foster homes with considerable psychological trauma in early life. Hypochondriacal behavior was reported by the mother. The mother was entirely receptive to psychiatric referral. When the child returned nine months later for testing, a normal audiogram was obtained (see Fig. 3).

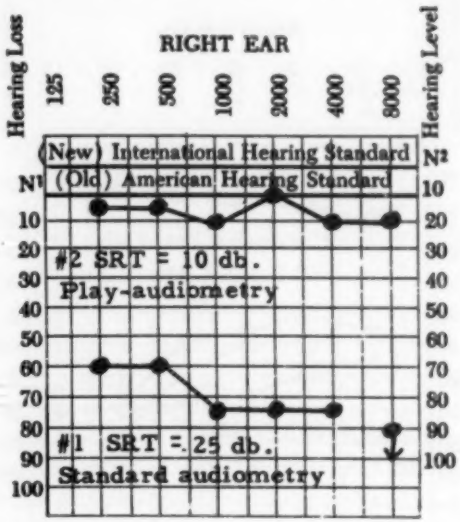


Fig. 2. Results of tests on one child showing consistent increase in listening ability. The numbers refer to order of test.

A boy, age 14, was failing in school and a poor reader. The mother reported an I.Q. test had been given and the child found to have normal intelligence. Early psychological trauma was present (this boy's father and older brother dying one month apart when the patient himself was three and one-half years of age). The boy has had six months of psychiatric treatment (see Fig. 4).

A girl, 14 years of age, had been given a hearing test at school, was permitted to see the audiometer and was able to observe that her hearing was poor in the left ear. This proved so upsetting to her that she stayed home from school unknown to her parents for ten weeks, dressing in the morning and calling in for assignments. No response to pure-tone or speech at maximum levels in the left ear was secured on her first audiometric examination in our office. Spondees were repeated at 5 db in the

right ear, but there were no pure-tone responses in that ear until levels of 60 to 90 db.

Return visits revealed wide fluctuations in speech reception thresholds as well as pure-tone thresholds. For the right ear, the ascending speech reception threshold was 50 db, the descending threshold 20 db with later correct spondee repetition at 2 db. Pure-tone threshold responses for the right ear, depending upon whether ascending or descending presentation was used, varied over a 20 to 35 db range. A few left ear responses were secured at 80 to 100 db with no response to spondees, but surprise directions were followed at levels as low as 20 db in that ear.

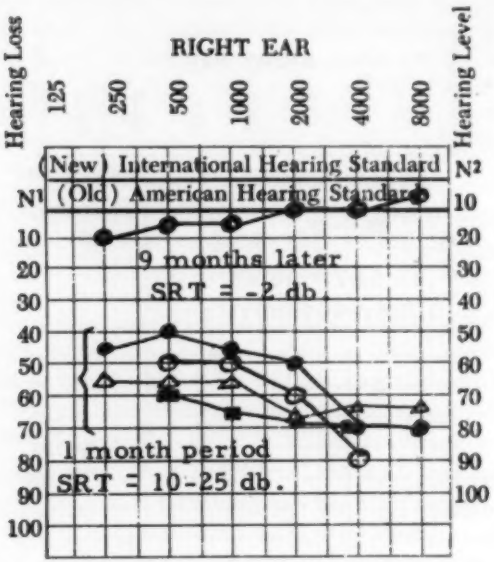


Fig. 3. Air conduction thresholds obtained for the same ear of one child over a one month period. Normal threshold obtained nine months later.

The Stenger tests and PGSR measurement were made, both tests revealing near-normal hearing in the left ear. Following the PGSR, the child evidently realized that the test had been beyond her control and that it had revealed better hearing than she previously had admitted. She then gave voluntary responses to pure-tones in the left ear at 10 to 25 db. Final discrimination tests were normal (96-98 per cent) in both ears when speech was presented at 25 db (see Fig. 5).

On conclusion of the voluntary tests revealing normal hearing, the audiologist commented, "That was much better. How do you explain that?" The child answered, "I guess my nose was stuffed up, and it cleared."

Following the school test, the child had been transferred to an integrated program for hard of hearing and deaf children. She had a teacher accompany her to the classes with normal-hearing children, the teacher writing down directions and explanations for her. The teachers felt that her hearing fluctuated.

The child was seen in a psychiatric clinic for evaluation and was found to be functioning at a bright level intellectually. Noted were the following:

1. Poor social adjustment with peers.
2. Basic insecurity, tense and anxious.

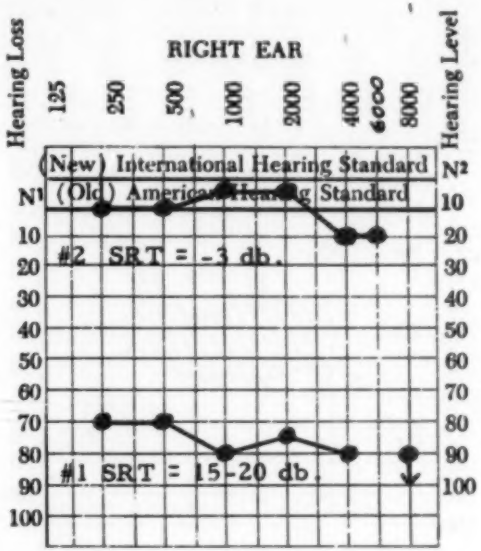


Fig. 4. Air conduction thresholds for the same ear of one child obtained on the same day. Normal threshold obtained following suggestion to the child that he had misunderstood directions or was pretending.

3. Strained relationship with mother.
4. Immature patterns of behavior.

Psychotherapy was recommended if difficulties in social adjustment persisted.

The fourth child, a 15-year-old male, was reported to have been failing in all subjects and expelled from a public school and a private school because he would not study. Temper tantrums at school had occurred with subsequent referral to a psychiatrist for six months' treatment. Four successive audiograms over a two-month period indicated a 65 to 95 db pure-tone bilateral loss with speech reception thresholds of 10 to 25 db.

Speech discrimination test errors and test behavior were markedly different from those normally expected with organically-impaired ears.

This child told the audiologist that he did not hear the sound (l) and proceeded to repeat "fap" for *flap*, "fing" for *fling*. When given the word, *puff*, he said, "I got the 'uff" (followed by a long pause) and then the question, "Did you say puff?" When given the word, *wire*, he was overheard to whisper to himself "wire, wire" before saying into the microphone the word, *fire*.

It was requested that he return for follow-up studies, but he was not seen for two years. An interview with his father prior to the audiologic

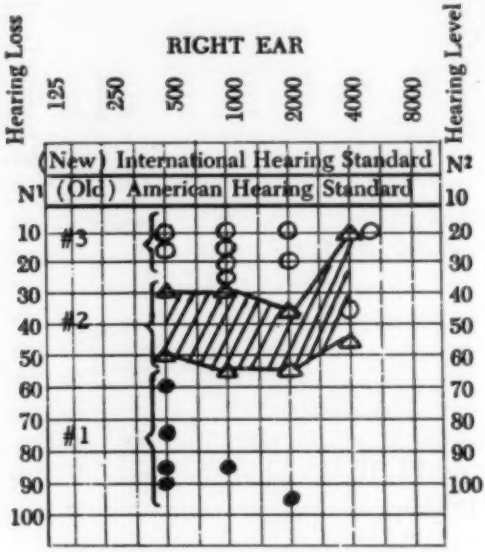


Fig. 5. Range of variability in air conduction thresholds for same ear of one child obtained on three successive visits. Shaded area indicates difference in ascending and descending thresholds on second visit.

testing at this time revealed his general psychological and emotional state had improved. He was described as being an entirely different boy, happier at home with fewer temper tantrums. Normal pure-tone and speech audiometric results were obtained without difficulty (see Fig. 6); however, on completion of the testing, the boy stated, "I wish I could see as well as I can hear. My eyes get weaker and weaker. I can't see anything in here clearly."

It should be emphasized that clues to non-organicity occur within the tests for speech reception threshold and speech

discrimination as well as in the completed test scores themselves. The response pattern of three children in this group was atypical, that is, differing from the responses of the normal or organically impaired ear.

Half-word spondees were frequently given, such as "boy" for *cowboy*. A grouping of errors might occur, the child

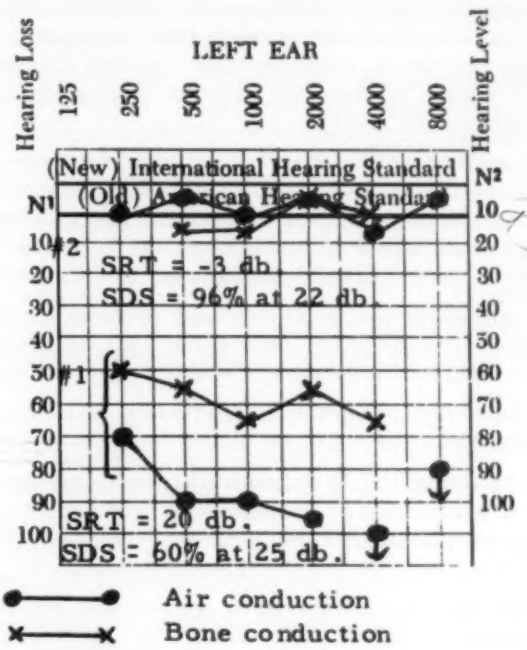


Fig. 6. Initial audiogram (No. 1) for same ear of one child compared with final audiogram (No. 2).

always giving the first syllable of a spondee as "foot" for *football*, "earth" for *earthquake*.

When given speech discrimination tests, several children were observed to substitute consistently words that rhymed with the test word (without relation to relative intelligibility). Long silences frequently followed the audiologist's word pres-

entation, the child later repeating the word hesitantly and with a rising inflection. A grouping together of identical types of error was observed, such as repeating seven words in a series each with the final consonant omitted.

CONCLUSION.

Otologists and school physicians who make recommendations for special classes should be aware that non-organic hearing problems can and do exist, and that the first clue to this is the discrepancy between the pure-tone audiogram and conversational-speech ability.

A diagnosis on the basis of the pure-tone audiogram alone is not sufficient, and speech audiometry should be considered absolutely essential in children's hearing tests. The speech reception threshold in most instances can be relied upon to come closer to the patient's actual loss.

The impression and final diagnosis of normal hearing is best made after complete otologic and audiologic evaluation and psychologic or psychiatric evaluation when indicated.

Full knowledge of the hearing mechanism and testing technique, together with adequate equipment is necessary.

The audiologist should possess sufficient background in the testing of normal ears and patients with organic losses so that the response pattern and test behavior of the patient with a non-organic loss will stand out as markedly different.

On the basis of our experience, we feel that the more deliberate and willfull the non-organic loss appears, the more closely scrutinized must be the entire school and home adjustment picture, and the more likely it is that psychiatric referral should be made.

The otologists may hesitate in some instances to confront a willfully malingering child directly with the statement that he hears normally; face-saving may be of great importance to a particular child. After testing, the suggestion to the child that his hearing is improved and much better can act as a necessary face-saving device. Frequently, simply telling the

child in a matter-of-fact way that the tests showed that he had normal hearing and that he must simply have misunderstood directions or perhaps was pretending may be indicated. The child may feel better having this out in the open and be somewhat relieved of the necessity to continue the pretense. This is not meant to imply that the underlying basic reasons for this behavior are in any way altered by such superficial treatment. In the conscious malingerer, this of course can be explored only through psychiatric evaluation.

With the child who is not willfully malingering and who exhibits no symptomatology other than the apparent inability to listen in the test situation, it would appear desirable to stop all testing at school. Testing should be performed as with the willfully malingering child only to the extent necessary in the otologist's office. Comments, both at home and at school, with reference to the child's hearing are probably best discontinued. Further elaboration or generalization as to causal factors, significance of this behavior or prognosis is not within the scope of this paper. We can recommend only continued observation and gathering of data by others.

BIBLIOGRAPHY.

1. Johnson, K.; Work, W., and McCoy, G.: Functional Deafness. *Ann. Otol., Rhinol. and Laryngol.*, 65:154-170, 1956.

2. Truex, E. H.: Psychogenic Deafness. *Connecticut Med Jour.*, 10:907-915, Nov., 1946.

3. Dixon, R. F., and Newby, H. A.: Children with Nonorganic Hearing Problems. *Arch. Otolaryngol.*, 70: No. 5, Nov., 1959.

4. Juers, A. L.: Pure Tone Threshold and Hearing for Speech-Diagnostic Significance of Inconsistencies. The Laryngoscope, 66:402-409, April, 1956.

5. Myklebust, H. R.: "Auditory Disorders in Children," pp. 252-269. Grune and Stratton, 1954.

6. Harris, D. A.: A Rapid and Simple Technique for the Detection of Non-organic Hearing Loss. *Arch. Otolaryngol.*, 69:758-760, Dec., 1958.

BILATERAL TONSILLECTOMY FOR PERITONSILLAR ABSCESS.*

BENJAMIN M. VOLK, M.D.,
and
EDWARD C. BRANDOW, JR., M.D.,
(By Invitation)
Albany, New York

In our opinion, bilateral tonsillectomy for peritonsillar abscess is the procedure of choice. Incision and drainage for peritonsillar abscess has been the standard accepted therapy literally for centuries. This procedure consists of the evacuation of pus, perhaps daily reopening of the incision and, some weeks later, tonsillectomy.

The patient, however, during the acute stage of the illness usually has marked dysphagia, drooling, severe pain, elevation of temperature and considerable dehydration. All of these symptoms, on the average, may persist for two to five days. We all have had the experience of not obtaining pus in incising what we thought surely was an abscess. We also may have repeated this frustrating experience daily for a few consecutive days. Eventually, the abscess would rupture spontaneously, as it does in the majority of cases, or extend laterally, posteriorly or inferiorly. Occasionally, troublesome bleeding would occur. Fortunately, a fatality would rarely result although it is a probability.

Historically, it is interesting to note the evolution of the surgical treatment of peritonsillar abscess. In the Fourteenth Century, Guy de Chauliac,[1] a French surgeon, described the procedure for incision and drainage. Essentially, this has changed in no respect up to the present time. As time passed, various progressive surgical modifications were recommended,

*Read at the Sixty-Third Annual Meeting of the American Laryngological, Rhinological and Otological Society, Inc., Miami Beach, Fla., March 16, 1960.

Editor's Note: This manuscript received in The Laryngoscope Office and accepted for publication April 6, 1960.

among them, incision and drainage with removal of a small piece of tonsil; the removal of only the upper half of the involved tonsil; partial dissection of the upper pole with luxation and removal of the entire tonsil a few days later when the severity of the acute infection had subsided; packing of the abscess-cavity for a few days with removal of the offending tonsil; and finally, bilateral tonsillectomy. In 1859, Chassaignac[2] performed the first complete tonsillectomy for peritonsillar abscess and was the first to describe an abscess forming in the loose connective tissue between the tonsil and the superior constrictor muscle.

The great volume of literature concerning this surgery emanated in Europe in the latter part of the Nineteenth Century and in the early decades of the Twentieth Century. Oddly enough, there are only a few articles on this subject in American literature, and none in the last quarter of a century. Dr. Harry Baum[3] of Denver gave a very enthusiastic and comprehensive paper in 1926 before the Midwestern Section of the American Laryngological, Rhinological and Otological Society in Omaha, Neb. The interest in what might be termed radical surgery was largely stimulated by many case reports of fatalities in this disease which occurred at this time. Many septic infections, therefore, were treated by tonsillectomy, with recovery, which resulted in many contributions to the literature of otolaryngology. It should be emphasized that all of this pioneer work was done before the introduction of chemotherapy and antibiotics.

Impressed by these large series of cases without any complications attributable to the surgery, we began this procedure in January, 1957. Since that time, it has been used routinely in all cases of peritonsillar abscess. We wish to present our experiences with 36 cases, being aware that the number of cases is statistically small and that no definite final conclusion can be made at the present time; therefore, this is considered a preliminary report. It is difficult to accumulate a large number of cases. Apparently, this acute condition is occurring less frequently because of the improving health of the general population and also through use of chemotherapy and antibiotics.

The surgery was performed by members of the attending and the resident staff in both the Veterans Administration Hospital and Albany Hospital. All of these cases were handled in similar fashion, each being given penicillin four or more hours before surgery. Another antibiotic was used if there was any question of penicillin sensitivity. If necessary, intravenous fluids were also administered. As indicated, routine preoperative medication was used.

Twenty-two of the 36 cases received local anesthesia, and 14 were done under endotracheal anesthesia. The type of anesthesia used depended on the patient's age and degree of apprehension, local anesthesia being preferable. In those patients receiving general anesthesia, it is important that a competent anesthesiologist be available and that the Rose position be used so that in case of spontaneous rupture of the abscess the dependent head position will preclude the possibility of aspiration.

The surgical technique was identical with that of a routine interval tonsillectomy and was no more difficult. The abscess actually separates a portion of the tonsil from its bed. After incision, one usually finds the tonsil more than half dissected. Local injection keeps bleeding at a minimum and is also used in conjunction with a general anesthetic. Trismus is not an inhibiting factor for the removal of the tonsil. Removal of the opposite tonsil is uneventful. We feel, however, that this is also necessary because of the high percentage of recurrence of an abscess and because of finding unsuspected asymptomatic pockets of pus.

Many of these patients were treated as emergencies, the surgery being frequently performed at night. Postoperatively, antibiotic therapy was continued for five days. The care was similar to that of a routine procedure. No patient had any associated medical condition that contraindicated the surgery.

Peritonsillar abscess is primarily a disease occurring in the prime of life. Grahne,[4] reporting 725 cases, found that 79 per cent were in the ten to 40 year age group, Bateman-Kodicek[5] found approximately 85 per cent incidence in the group of

120 cases. In our series, the same age group incidence was 80 per cent.

Peritonsillar abscess is not always located anteriorly at the superior pole; therefore, the usual diagnostic criterion of a markedly injected bulging upper pole with deviation of the uvula is not always reliable. These signs may not be present. If the abscess or abscesses are located elsewhere in the tonsillar fossa, one must rely on history and the presence of trismus. Virtanen's[6] series of 379 cases shows only 51 per cent had an upper pole abscess and 0.9 per cent was multilocular. In the Bateman-Kodicek series of 120 cases, 50 per cent was located at the upper pole, 5 per cent was multilocular. Virtanen also found 14 per cent had bilateral abscess involvement. Grahne also found bilateral involvement in 7 per cent. In our series, 62 per cent had an abscess in the upper pole, 10 per cent was multi-locular or multiple and 8 per cent or three cases were bilateral, all masked on the uninvolved side and found incidentally. The remainder was located in different areas in the fossa.

In this series, the duration of symptoms varied from two to seven days. Twenty-two patients stated that they had one or more attacks of tonsillitis, and four others had had one or more attacks of peritonsillar abscess, each having had one or more episodes of incision and drainage. One patient had had a tonsillectomy performed seven years previously. Two patients had extension of the infection to the para-laryngeal region with swelling of the epiglottis.

Preoperatively, all of the patients had some elevation of temperature ranging from 99.4° F. to 102° F., with two having 103° F. and one 104° F. Postoperatively, all patients, with three exceptions, had normal temperatures within four to 24 hours. These all subsided within 48 to 72 hours. The majority of patients operated upon at the Albany Hospital was discharged within 24 to 48 hours, none remaining for more than 96 hours. Bacteriologically, only 17 cases were reported as follows: five—beta hemolytic streptococcus; ten—streptococcus viridans; and two—diplococcus pneumonia.

No fatalities or complications were reported either in

Grahne's 725 cases or Bateman-Kodicek's 120 cases. These patients, postoperatively, reacted similarly to those having an elective tonsillectomy, and no unusual bleeding occurred. These series are being presented because they are recent and occurred in the post-antibiotic era. In our series, no primary or secondary hemorrhage occurred.

Not all of the cases came directly under our care but were first managed conservatively by others. These cases help illustrate the advantage of the one-stage immediate tonsillectomy. Two cases had spontaneous rupture with abatement of symptoms, yet pus was found at the operation the next day. One case had incision the day before with no pus. A large pocket was found behind the inferior pole during tonsillectomy. Another had incision and drainage with complete subsidence of symptoms, yet seven days later, pus was found at the operation. Without tonsillectomy, each of these cases would have had residual pus left in the throat. Certainly, the three cases with pus behind the opposite and unsuspected side were much benefited.

Tonsillectomy for peritonsillar abscess conforms to the basic surgical principles of adequate incision and dependent drainage. The entire medial wall is excised. Simple incision for drainage is not comparable. Drainage is not dependent for residual pockets may be left behind, possibly resulting in more abscess formation or possible extension to the parapharyngeal or the paralaryngeal region. Operative trauma or injection in an area of cellulitis has not caused either local or systemic spread of infection. If a single cavity has been successfully incised and drained, the patient may either not return in the optimum time for interval tonsillectomy, or may not return at all. This results in the tonsil's becoming exceedingly scarred in the fossa, making dissection exceedingly difficult. As a result, excessive scar tissue may leave tonsillar tissue behind which in itself may cause a recurrence of infection or an abscess.

COMMENT.

Immediate tonsillectomy as a one-stage procedure is the

treatment of choice in the management of peritonsillar abscess. This has many advantages over incision and drainage. The only method of obtaining adequate and dependent drainage is by removal of the tonsil. Incision alone may leave behind residual pockets of pus, particularly if the abscess is multi-loculated. Incision may fail to give pus as the abscess is not located behind the upper pole in a significant number of cases. After incision, additional procedures for further evacuation of pus may be necessary on the second and third days. Enough patients have pus on the opposite side to warrant doing a bilateral tonsillectomy. The abscess separates the tonsil from its bed and after adequate incision, the tonsil is usually more than half dissected out. Bleeding is kept at a minimum by local injection. Antibiotics protect against further spread of infection. The complications from the operation are no higher than with interval tonsillectomy. These patients, postoperatively, are most grateful to be so immediately relieved of their acute discomfort. Their postoperative course is uneventful. The convalescence of the one-stage operation is certainly much decreased. This procedure has been performed in over 4,000 cases for the most part in Europe, and to a large extent, before the days of antibiotics. It has been found to be a safe and effective method.

CONCLUSION.

We have presented our experiences with 36 cases. Small though it may be, it is hoped to stimulate interest in this country, in what we feel is a very rewarding procedure.

BIBLIOGRAPHY.

1. Chauliac, Guy de: Cited by Stevenson and Guthrie.
2. Chassaignac: Cited by Virtanen.
3. Baum, Harry: *Ann. Otol., Rhinol. and Laryngol.*, 35:429, 1926.
4. Grahne, Bertel: *Arch. Otolaryngol.*, 16:332, 1958.
5. Bateman-Kodicek: *Ann. Otol., Rhinol. and Laryngol.*, 68:315, 1959.
6. Virtanen, V. S.: *Acta Oto-laryngol., Stockholm*, Suppl. 80, 1949.

LYMPHOSARCOMA OF TONSIL.

Discussion and Report of Case with Recovery.*†

FORDYCE JOHNSON, M.D.,

Pasadena, Calif.

Lymphosarcoma of the tonsil is a rare disease,[1] and when a case is seen by the surgeon, it does cause a sense of concern with foreboding of fatality; however, the prognosis is more favorable than is generally realized, and with today's therapy the patient does have a near 40 per cent chance of recovery.[2,3,4] Not to leave too rosy a picture, there are basic facts that must be considered.

Lymphosarcoma is a cancer of non-epithelial origin arising in lymphatic tissue. Lymphosarcoma may arise in practically any organ or gland, and spread to any area of the body. It is notorious for sparing little, and harming much. It occurs in all ages, males slightly more than females, and in all races.

Just how rare is lymphosarcoma of the tonsil? The incidence is well shown by a summary of cases as reported by the Tumor Registry at the Los Angeles General Hospital.[5] During the period 1944-1958, 14 years, there were two cases of lymphosarcoma of the tonsil and one case of reticulum cell sarcoma of the tonsil reported. During this same period there were 131 cases of carcinoma of the tonsil reported. During this 14-year-period there were 26,731 neoplasms registered at the Los Angeles General Hospital Registry. The surgical load at that hospital for this same period, 1944-1958, was 188,758 patients.

The annual patient load, both in and out patients, during this past 14 years has been 80,366 patients. The total load for the 14-year period makes a grand total of 1,125,124 pa-

---

*Read at the meeting of the Western Section, American Laryngological, Rhinological and Otological Society, Inc., Denver, Colo., Jan. 22, 1960.

†From the Department of Otolaryngology, University of Southern California.

Editor's Note: This manuscript received in The Laryngoscope Office and accepted for publication Feb. 25, 1960.

tients seen. The rate of incidence, using these statistics, would mean that one patient in 375,000 patients would develop lymphosarcoma of the tonsil, and that about one case of lymphosarcoma of the tonsil would appear for each 62,000 surgical cases operated upon for all conditions.

The consideration of clinical findings aids in an evaluation both as to treatment and prognosis. A classification as presented by Diamond[6] for lymphosarcoma is as follows:

Class 1. Disease limited clinically to a single focus, with no constitutional symptoms; *i.e.*, fever, weight loss, anemia, fatigue, etc.

Class 2. Disease limited regionally, such as homo-lateral cervical adenopathy, with or without constitutional symptoms.

Class 3. Generalized disease with constitutional symptoms and signs.

Using this classification, the physician is in a better position to consider the form of therapy to be used; whether surgery, X-ray, chemotherapy, or a combination of these three.

The pathological classification of lymphosarcoma, by Herbut,[7] designates the types as follows:

1. Giant Follicular Lymphoblastoma.

There is an increase in the number and size of the lymphoid follicles. The follicles are composed of reticulum cells in the center, lymphoblasts beyond these, and lymphocytes at the periphery. This is the least malignant of the lymphoblastomas. When it terminates in the death of a patient it may still remain in its initial form, or may be transformed into lymphosarcoma, lymphatic leukemia, Hodgkin's disease or reticulum cell sarcoma. This shows the close relation among the lymphoblastoma group of diseases. In the borderline cases the separation of this group from the less differentiated forms is largely arbitrary. Different names have been applied to giant follicular lymphoblastoma including: malignant lymph follicle hyperplasia, follicular lymphoblastoma, follicular lymphadenoma, follicular lymphoma, and Brill-Symmer's disease.

2. Lymphosarcoma.

The more advanced stage with the lymph node diffusely involved. This may also represent a local, regional or generalized disease. In time these patients may show blood and marrow changes of chronic lymphatic leukemia. The cells of the lymph node may be small and mature, (lymphocytic lymphosarcoma), or large (lymphoblastic lymphosarcoma).

3. Hodgkin's Disease.

This disease is often divided into a sarcomatous and granulomatous variety. The sarcomatous form is less common with the dominant cell identical with reticulum cell sarcoma, and is considered as a granulomatous form which has been transposed into the more malignant type. The granulomatous type is the usual form in Hodgkin's disease. Histologically, there is complete loss of normal glandular structure, with a diffuse infiltration of a variety of cells including lymphocytes, plasma, monocytes, neutrophiles, and Sternberg-Reed cells.

4. Reticulum Cell Sarcoma.

Here the node is replaced by reticulum cells, which may also be a local, regional, or a generalized disease. In this group the predominant cell type is greater than two to four times the size of the mature lymphocyte. This group includes stem cell lymphomas, lymphoblastomas, and lymphoblastic lymphoma. It should also be stated that serial sections of a node or of nodes may manifest all stages or types of lymphosarcoma including the above manifestations.

The average survival[7] of patients with giant follicular lymphoblastoma is 4.6 years; of lymphosarcoma and Hodgkin's disease about two years, and of reticulum cell sarcoma about six months.

The development of lymphosarcoma is insidious. There is no discomfort noted during the earliest stages. In the tonsil area, obstruction because of size may be the first complaint. In the late stages the findings are those of a generalized cancer with anemia, cachexia, weight loss and shortness of breath, etc.

The diagnosis is made by examination and confirmed by biopsy. The significant finding is the marked enlargement of only one tonsil, which may be three, four or five times the size of the average tonsil. In a recent survey[8] of 422 tonsils, the average weight, all ages, was from 4.5 grams to 8.5 grams. (Case 1 weighed 22 grams.) The involvement of the tonsil is usually so extensive that removal of the tonsil seems indicated, and the more expedient procedure. A biopsy, or removal of a small portion of the tonsil may not give the patient relief from obstruction symptoms. A biopsy may not present an accurate pathological picture. This is due to the nature of the disease where different stages or types of the disease may be present in the larger specimen.[1]

The treatment of lymphosarcoma of the tonsil as compared to involvement in other parts of the body, is surgical removal of the involved tonsil as indicated above; however, this represents only the first phase of treatment, for the second, and most important phase, is radiation therapy. The treatment of choice for lymphosarcoma is X-ray. Surgery, except for diagnosis, is not advocated.

Patients in Class 1 should be treated aggressively by X-ray with potential cure in mind following the removal of the involved tonsil.[9] Certainly it seems unwise to do a bilateral tonsillectomy just because you are working in the throat. To save the patient as much as possible and maintain his health, is the surgeon's first concern during this preliminary, critical stage.

Class 2 patients need much more intensive X-ray therapy with the Roentgen dosage increased, and given in multiple portals to cover the involved area. The desired dosage to be designated by the radiologist.

Class 3 patients fall into the palliation therapy group. The dosage used is mainly to lessen the size of the tumor mass, and decrease symptoms. In this group chemotherapy may also be used. While chemotherapy has been used with temporary relief, this form of therapy should not be relied upon as curative.

Chemicals used include Nitrogen Mustard (HN2). This is of help in Classes 2 and 3 where remissions occur of weeks to months. HN2 is given intravenously in a single 0.4 mgm. per Kg. dose, or divided doses in a period of several days. Should this be considered in treatment, Diamond[6] has presented an excellent report on its use.

Triethylene Melamine (TEM) is a compound with Nitrogen-Mustard-like action. It is given orally. It has the ability of acting like radiation therapy in controlling lymphosarcoma but without the same lasting effects of X-ray. It has adverse reactions which should be watched for. These reactions include a depression of the white blood cells and platelets, and the presence of hyperuricemia.

CASE REPORT.

M.A., white female, six years of age, was first seen October 19, 1956, with a history of having a husky voice of three weeks' duration. One week prior to being seen, there was difficulty in swallowing and a definite mouth breathing which had not been present before. The patient did not complain of pain, had no fever, and except for her muffled voice, did not appear in discomfort.

The past history of the patient was essentially negative, no history of sore throats, no ear trouble, no allergy history.

Examination showed a well developed white female. Ears, canals clean, TM grey and glistening; nose, normal in appearance; throat, right tonsil presented a very large mass approximately 2x4 cm. extending into the right pyriform sinus. The mass was not ulcerated, and had a smooth, red surface; the left tonsil was moderately enlarged, a mild chronic inflammation present; pharynx showed no acute infection, no edema of the palate; cervical adenopathy, right 2 plus, left, 1 plus, no tenderness in the tissue of the neck. Spleen not palpable.

The patient was admitted to the hospital the same afternoon she was first seen. X-rays of the chest were ordered and also a complete blood count. The X-ray report follows:

PA and left lateral views were taken. The visible bony thorax appears intact. The diaphragm is smooth and at normal levels with clear costophrenic sulci. The heart is oblique in type and well within normal limits, as to size and configuration. The great vessels and trachea are within normal limits. There is a fullness in both hilar regions. In the right hilus, there is a suggestive shadow of a 1 cm. lymph node overlying the pulmonary segment. In the left hilus, the hilus is slightly enlarged and slightly lumpy suggesting possibility of lymph nodes in this area. The remainder of the lung fields are essentially clear. The lateral view adds no additional information.

Roentgen Conclusion: Quite suggestive for early hilar lymph adenopathy. This would bring up the possibility of a lymphoma. Otherwise negative heart and lungs.

The C.B.C.: Hemoglobin 13.0 gms.; W.B.C. 9,900; Neutrophiles 31%;

(Segmented 31%); Eosinophiles 9%; Lymphocytes 52%; Monocytes 8%.

Urine: specific gravity 1.021; pH 5.0; pus cells 5-6.

The patient was taken to surgery the following morning, and a right tonsillectomy was done with the patient in the Rose position. The left tonsil was left intact. The mass removed dissected freely at the upper pole, but was more adherent at its base. The mass extended into the right pyriform sinus and encroached upon the right wall of the epiglottis. When the tumor was removed, the fossa presented a clean base. One tie was placed in the right tonsil fossa. The pathology report follows:

The specimen consists of 22 gms. of tonsil tissue, measuring 4x3.5x2.5 cm. in its greatest dimensions. The cut surface shows a homogeneous pink-tan fleshy tissue, lacking any gross follicular pattern. There are no crypts in the center of the specimen.

Microscopic: There is almost total disorganization of normal architecture. The bulk of the specimen consists of a monotonous growth of large lymphocytes, without evidence of significant reticulum or fibrous connective tissue proliferation.

Diagnosis: Lymphosarcoma right tonsil.

The patient was discharged to her home October 23, and was seen on the tenth postoperative day, October 30, at which time the throat was healing nicely. She reported to the Roentgenologist for X-ray therapy November 1, 1956. She received a total of 3000 Roentgens from November 1 to November 29, 1956. The patient continued to improve and upon subsequent visits the cervical adenophy disappeared. She is now in good health, and at the last examination November 16, 1959, presented no evidence of disease.

In checking the hospital records, a second case of lymphosarcoma of the left tonsil in a six-year-old male was found. This is the second case located in a ten-year period in a surgical case load of 78,662 patients. The case history follows:

CASE REPORT No. 2.

J.V., white male, age six years, was first seen June 10, 1955, with a history of sore throat of approximately two months' duration, dysphagia two plus weeks, and dysphonia the past ten days. In the ten days prior to being seen there was noted enlargement of the glands in the left cervical area. The patient was admitted to the hospital June 14, 1955.

Physical examination at the time of admission presented a well developed male child with dysphonia but no respiratory distress. Ears, canals clean, TM grey and glistening; nose, normal in appearance; throat, right tonsil small in size; left tonsil, marked hypertrophy, approximately 3.5x2 cm. with erosion of its medial surface. Neck, marked adenopathy of left cervical glands adjacent to the sternomastoid muscle. Heart and lungs normal, spleen not enlarged.

The patient was taken to surgery June 15, 1955, and a left tonsillectomy was done. The tonsil shelled out of its capsule with no great difficulty, and two ties were placed in the left tonsil fossa. The right tonsil and the adenoids were not removed.

Pathology report: The specimen consists of an irregular mass of tonsil tissue measuring 4 cm. in its greatest dimensions, and weighing 13 gms.

Microscopic: Shows almost complete obliteration of the follicular pattern. Mitotic figures are quite common. The bulk of the tumor consists of large hypochromatic cells of the lymphocytic series.

Diagnosis: Lymphosarcoma of left tonsil.

The patient was discharged the following day, and was checked postoperatively on June 25. In the meantime, therapy was requested through the City of Hope, and the patient was admitted to this hospital on June 27, 1955, as an out patient. He received a total of 4275 Roentgens during the next 30 days. The patient gradually became worse, and was admitted to the City of Hope Hospital on August 15, 1955, with an elevation of temperature, and swelling of the left side of the neck. He became progressively worse until September 1, 1955, when a tracheotomy was done because of increased dyspnea. The patient expired on September 2, 1955. An autopsy was refused by the parents.

SUMMARY.

A review of the clinical classification, also pathological, findings, and treatment of lymphosarcoma is presented.

The treatment of choice is radiation therapy, perferably given early and in adequate dosage.

A case presentation of a six-year-old female with recovery, and a six-year-old male who did not recover is given.

BIBLIOGRAPHY.

1. Hirst, O. C., and Charland, R. A.: Lymphosarcoma of the Tonsil. *Arch. Otolaryngol.*, 54:60-64, July, 1951.

2. Parshall, D. B., and Stenstrom, K. W.: Malignant Lesion of the Tonsil. *Radiol.*, 60:564-572, April, 1953.

3. Fostvedt, L. M. R., and Fostvedt, G. A.: Lymphosarcoma of the Tonsil. *Arch Otolaryngol.*, 61:465-467, April, 1955.

4. Acherman, Lauren V., and Regato, Juan A.: "Cancer," Ed. 2, page 371. C. V. Mosby Co., St. Louis, 1954.

5. Personal Communication, Tumor Registery L.A.G.H., Los Angeles, Calif.

6. Diamond, H. D.: The Natural History and Management of Lymphosarcoma. *Med. Clin. N. Amer.*, 40:721-742, May, 1956.

7. Herbut, Peter A.: "Surgical Pathology," Ed. 2, pp. 572-577. Lea & Febiger, Philadelphia, 1954.

8. Special study, not reported to date by author.

9. Seltzer, A. P.: Lymphosarcoma: A Problem for the Nose and Throat Specialist. *Ann. Otol., Rhinol. and Laryngol.*, 68:222-226, March, 1959.

PSYCHOGENIC PROBLEMS.*

C. STEWART NASH, M.D.,

Rochester, N. Y.

The motto of the University of Salamanca reads: *What nature hath denied, this University cannot provide.*

What a travesty on the practice of medicine! St. Luke, a fellow physician, would have said . . . *be of good comfort, thy faith "hath made thee whole." (St. Luke 8-48.)*

Far be it from me to belittle the values of modern surgery and wonder drugs, but I admonish you to regard with respect the clinical and psychogenic importance of modern *Empiricism.*

Empiricism—or "Empirics" as it was called—began in the Second Century B.C. as one of the post Hippocratic Schools of Medicine. In its search for a line of treatment to benefit a particular set of symptoms, this school employed what it called *The Tripod of Empirics* the legs of which were:

a. One's own observations;

b. Learning obtained from contemporaries or predecessors and

c. Analogy—that is, in case of new diseases, the forming of conclusions from a study of known maladies which resembled those under consideration.

So far as I have been able to ascertain this tripod soon came to include any and all methods of healing (medical, surgical, psychogenic, spiritual, ad infinitum), orthodox and unorthodox.

With the advent and growth of this School of Empirics, the old Cock-of-the-roost game began. The Cock and his

---

*Read at the meeting of the Southern Section, American Laryngological, Rhinological and Otological Society, Inc., New Orleans, La., Jan. 15, 1960.

Editor's Note: This manuscript received in The Laryngoscope Office and accepted for publication Jan. 22, 1960.

loyal supporters were orthodox practitioners; those with ideas unacceptable to the group were "quacks." This Cock-of-the-roost situation has come down through the ages and continues unabated; repeatedly, however, there have been changes of actors and scenes.

Let us meet the situation head on! The cries of "Quackery" and "Charlatanry" come from doctors—rarely from patients—Why?

1. In time the doctor *should* know whether a given preparation or procedure is valuable or value-less.

2. In time the doctor *should* know whether a given preparation or procedure is harmful or harmless.

Unfortunately, a doctor may come up with the wrong answers to both these propositions and thereby fail to recognize a medical prize worth striving for.

It is within this uncertain Cock-of-the-roost medical environment that *some* of our psychogenic problems arise.

Others—as we shall see—are of a more personal nature.

First, we shall observe some of the environmental shifts in medicine, all of which have had and are continuing to have psychogenic repercussions in both patients and doctor.

a. Personally I have read dozens of testimonials concerning the benefits from two of the most remarkable pain relieving remedies this country has ever known. Of course, they contained whisky and opium, but no one became an alcoholic or a drug addict; he simply kept on taking such an easily procurable patent medicine and lived happily ever after. Peter B. Kyne's book "The Clarion" took care of the immediate situation, but the psychogenic problem created by unremitting pain and distress remained. Replacing whisky and opium combinations, we now have barbiturates and tranquilizers, but to what avail?

b. As a teen-ager I was acquainted with itinerant Medicine Shows. I have known of patients having teeth pulled "pain-

lessly" in public and with the percussion of a bass drum as the only anesthesia.

Within the last six to seven months the Ritter Company, Inc., of Rochester, New York, received an order for 1,000 newly blue-printed Sono-Anesthesia units to relieve pain and to be used for other symptoms in and about the ears and head. Doctor Hallowell Davis, Director of Research at Central Institute for the Deaf in St. Louis, informs me that both the apparatus and its usage are safe and effectual means of treatment.

Three months ago an English otologist requested a place on the annual program of the Triological Society to read a paper on "Supra-Sonic Sound" as a surgical procedure in the management of Meniere's disease.

c. As a young aural surgeon I pooh-poohed "Sound Stimulation" and "Otitic Vibration" an effective or ineffective psychobiological agents in the handling of disorders of the ear. Today, I am constrained to give thought to "Medical Acoustics" and "Stapes Mobilization" as the legitimate progeny of these psychogenetic grandparents.

d. Also within the last year one of our own "Triological" members has popularized the use of vinegar and honey and—other home remedies in a book called "Folk Medicine" that has been on the best-seller list of the *New York Times* for about eight months and to date has had sales in excess of 245,000 copies.

So far we have brought forward for illustration four environmental shifts in medicine that somewhere in their elucidation have contained real or suspected elements of psychogenesis.

May we return to our simile? The doctors are the Cocks-of-the-roost; it is they who attempt to adjudge which factors in modern empiricism are based on psychogenetic phenomenon and which are founded on organic response—but doctors can be wrong. This, the patients know, and therein lies an occult and taboo psychogenetic situation.

Second, shall we remove ourselves from these environmentally psychological problems to more intimate and personal ones?

PERSONAL PSYCHOGENETIC STOCK-IN-TRADE.

A. Salesmanship.

B. The Doctor-Patient Relationship.

C. Wisdom.

D. Words.

A. Salesmanship.

Never have I experienced an empiric—ancient or modern; false or true—defaulting on salesmanship.

For years I listened agog and with vaudeville-like attention to the preachments of Dr. Brinkley—and what a power he was! $50,000 a week, I am told, it cost to operate his broadcasting station, first in Medford, Kansas, and later in Del Rio—just across the line. People loved his brand of medicine and they almost elected him Governor of the "Sun Flower State."

Of lesser lights there was Dr. Locke, the Canadian physician, who never charged more than $1.00 a treatment and who from his rocking chair in an orchard saw several hundred patients a day.

Please understand me, I do not recommend showmanship in the practice of medicine, but I do say that medicine is not and perhaps never will be just human engineering and chemistry.

B. The Doctor-Patient Relationship.

What is *not* appreciated by some doctors—though it is perceived by their patients—is the power for good or ill that lies in the interplay of doctor-patient personalities.

You are familiar with this phase of the subject.

C. Wisdom.

Paracelsus once said: *"The greatest and highest of all qualifications which a physician should possess is wisdom—and without this qualification all his learning will amount to little or nothing. We cannot find wisdom in books, nor in any external thing. We can find it only within ourselves."*

D. Words.

Of all the technical aids which increase the doctor's power of observation, none comes even close in value to the skillful use of words—the words of the doctor and the words of the patient. Throughout all of medicine, use of words is still the main diagnostic technique—and while in therapy many mechanical and chemical aids are truly miraculous in their effectiveness, words continue to play a tremendous role.

The aim in talking with a patient is to find out not only about his immediate symptoms but about him—his strength and weaknesses, his experiences throughout life and his reaction to them.

In medical school a student spends hours in learning to dissect, to palpate, to percuss, etc.—all essential things—but he is presumed to know how to talk. This is *not* necessarily true.

Success in talking with a patient will certainly be enhanced if the doctor acts like a cheerful human being, sincerely interested in the doings of another human being.

Quizzing, grilling, and the third degree have no place at all in talking with a patient. Remember the patient cannot talk while the doctor is talking—so often the less said the better. Listening is made easier if the doctor realizes that there is no need to make a diagnosis out of every bit of information and does not feel compelled to give premature advice.

Be circumspect in dealing with all patients, particularly the difficult or angry patient. Help him to talk about his angry feelings. Anger often is a defense against anxiety—anxiety from any cause. Sometimes the patient makes the doctor angry; sometimes the doctor makes the patient angry.

In any case, ideas that float around unspoken are tremendously threatening because they have no boundaries; no limits. Once they are put into words they are to a great extent fixed within the limits of those words.

If they can be examined as an object, an object that both the doctor and the patient can see, then the threat is largely lost.

Dr. Brian Bird, Associate Professor of Psychiatry at Western Reserve University, who is responsible for most of these ideas on "words" has said that a common tendency among many doctors is to talk too much to patients about themselves and their families.

Matching symptoms with a patient may be fun but it is hardly sporting, and one never knows where it will end.

REFERENCES.

1. Burnell, C. Sidney: "The Physician and His Practice," Edited by Joseph Garland, M.D., p. 6. Little, Brown & Co., Boston and Toronto, reprinted April, 1956.

2. Binger, Carl: "The Doctor's Job," p. 32, 46-51,. W. W. Norton Co., Inc., New York, 1st Ed., 1945.

3. Bird, Brian: "Talking with Patients," p. 1, 7-62. J. B. Lippincott Co., Philadelphia and Montreal, 1955.

4. Christian Science. "The Encyclopedia Americana," Vol. 6, p. 612. Americana Corp., New York, Chicago and Washington, 1957.

Medical Arts Bldg.

TEMPLE UNIVERSITY SCHOOL OF MEDICINE AND HOSPITAL.

A course in stapes and tympanoplastic surgery will be given at Temple University Medical Center. For information write: David Myers, M.D., Professor and Head of the Department of Otorhinology, Philadelphia, Pa.

PAN-PACIFIC SURGICAL ASSOCIATION.

Eighth Congress.

Honolulu, Hawaii, September 27-October 5, 1960.

The Eighth Congress of the Pan-Pacific Surgical Association will be held in Honolulu, Hawaii, September 27 through October 5 in 1960.

All members of the profession are eligible to register and are urged to make arrangements as soon as possible if they wish to be assured of adequate facilities because of limited space.

An outstanding scientific program by leading surgeons promises to be of interest to all doctors. Ten surgical specialty sections are to be held simultaneously.

Further information and brochures may be obtained by writing to Dr. F. J. Pinkerton, Director General of the Pan-Pacific Surgical Association, Suite 230, Alexander Young Building, Honolulu 13, Hawaii.

COLBY COLLEGE EIGHTH CONSECUTIVE INSTITUTE ON OCCUPATIONAL HEARING LOSS.

Colby College, in Waterville, Maine, announces its Eighth Consecutive Institute on Occupational Hearing Loss, August 8-13. The course is designed to train physicians, plant nurses, plant engineers and others in initiating and conducting hearing conservation programs in noisy industries. The course is comprehensive and includes all phases of the problem. The fee of $200 includes tuition, board and room. Requests for further information should be made to William A. Macomber, Colby College, Waterville, Maine. Dr. Frederick T. Hill and Dr. Joseph Sataloff are directors of the program.

DIRECTORY OF OTOLARYNGOLOGIC SOCIETIES.

(Secretaries of the various societies are requested to keep this information up to date).

AMERICAN ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY.

President: Dr. Erling W. Hansen, 90 So. Ninth St., Minneapolis, Minn.
Executive Secretary: Dr. William L. Benedict, Mayo Clinic, Rochester, Minn.
Meeting. Palmer House, Chicago, Ill., October 9-14, 1960.

AMERICAN ASSOCIATION FOR CLEFT PALATE REHABILITATION.

President: Dr. J. J. Longacre, 1503 Carew Tower, Cincinnati, O.
President-Elect: Dr. D. C. Samuel Pruzansky, D.D.S., 840 So. Wood St., Chicago, Ill.
Secretary-Treasurer: Dr. Spriestersbach, Ph.D., Department of Otolaryngology, University Hospital, Iowa City, Ia.
Meeting:

AMERICAN BOARD OF OTOLARYNGOLOGY.

President: Dr. Gordon D. Hoople, 1100 E. Genesee Dr., Syracuse 10, N. Y.
Secretary: Dr. Dean M. Lierle, University Hospital, Iowa City, Ia.
Meeting: Palmer House, Chicago, Ill., October, 1960.

AMERICAN BRONCHO-ESOPHAGOLOGICAL ASSOCIATION.

President:
Vice-President: Dr. Daniel C. Baker, Jr., 903 Park Ave., New York, N. Y.
Secretary: Dr. F. Johnson Putney, 1712 Locust St., Philadelphia 3, Pa.
Treasurer: Dr. Charles M. Norris, 3401 Broad St., Philadelphia, Pa.
Meeting: Lake Placid Club, Essex Co., N. Y., May 20, 1961.

AMERICAN LARYNGOLOGICAL ASSOCIATION.

President: Dr. Edwin N. Broyles, Baltimore, Md.
Secretary: Dr. Lyman G. Richards, Wellesley Hills, Mass.
Treasurer: Dr. Francis E. LeJeune, New Orleans, La.
Editor, Historian, and Librarian: Dr. Francis W. Davison, Danville, Pa.
Meeting: Lake Placid Club, Essex Co., N. Y., May 21-22, 1961.

AMERICAN LARYNGOLOGICAL, RHINOLOGICAL AND OTOLOGICAL SOCIETY, INC.

President: Dr. Fletcher D. Woodward, 400 Locust Ave., Charlottesville, Va.
President-Elect: Dr. John R. Lindsay, Chicago, Ill.
Secretary: Dr. C. Stewart Nash, 700 Medical Arts Bldg., Rochester 7, N. Y.
Treasurer: Dr. K. M. Day, 121 University Pl., Pittsburgh, Pa.
Annual Meeting: Lake Placid Club, Essex Co., N. Y., May 23-24-25, 1961.

AMERICAN MEDICAL ASSOCIATION, SECTION ON LARYNGOLOGY, OTOLOGY AND RHINOLOGY.

Chairman: Dr. Paul H. Holinger, Chicago, Ill.
Vice-Chairman: Dr. Lawrence R. Boies, Minneapolis, Minn.
Secretary: Dr. Walter E. Heck, San Francisco, Calif.
Representative to Scientific Exhibit: Dr. Walter H. Maloney, Cleveland, Ohio.
Section Delegate: Dr. Gordon F. Harkness, Davenport, Ia.
Alternate Delegate: Dr. Dean M. Lierle, Iowa City, Ia.
Meeting:

AMERICAN OTOLOGICAL SOCIETY, INC.

President: Dr. Henry L. Williams, Rochester, Minn.
Vice-President: Dr. Lawrence R. Boies.
Secretary-Treasurer: Dr. James A. Moore, New York City, N. Y.
Annual Meeting: Lake Placid Club, Essex Co., N. Y., May 26-27, 1961.

AMERICAN OTORHINOLOGIC SOCIETY FOR THE ADVANCEMENT OF PLASTIC AND RECONSTRUCTIVE SURGERY.

President: Dr. Joseph Gilbert, 111 E. 61st St., New York, N. Y.
Vice-President: Dr. Kenneth Hinderer, 402 Medical Arts Bldg., Pittsburgh, Pa.
Secretary: Dr. Louis Joel Feit, 66 Park Ave., New York 16, N. Y.
Treasurer: Dr. Arnold L. Caron, 36 Pleasant St., Worcester, Mass.

AMERICAN RHINOLOGIC SOCIETY.

President: Dr. Roland M. Loring, 25 E. Washington St., Chicago, Ill.
Secretary: Dr. Robert M. Hansen, 1735 N. Wheeler Ave., Portland 17, Ore.
Annual Clinical Session: Illinois Masonic Hospital, Chicago, Ill., October 6-7, 1960.
Annual Meeting: October 8, 1960, Belmont Hotel, Chicago, Ill.

AMERICAN SOCIETY FOR HEAD AND NECK SURGERY.

President: Dr. John J. Conley, New York, N. Y.
Vice-President: Dr. Joseph H. Ogura, St. Louis, Mo.
Treasurer: Dr. F. Johnson Putney, Philadelphia, Pa.
Secretary: Dr. George A. Sisson, Syracuse, N. Y.
Annual Meeting: Palmer House, Chicago, Ill., October 1, 1960.

AMERICAN SOCIETY OF FACIAL PLASTIC SURGERY.

President: Dr. Sam H. Sanders, Memphis, Tenn.
Vice-President: Dr. John T. Dickinson, Pittsburgh, Pa.
Treasurer: Dr. Joseph C. Miceli, Brooklyn, N. Y.
Secretary: Dr. Samuel M. Bloom, 123 E. 83rd St., New York 28, N. Y.
Meeting: Palmer House, Chicago, Ill., October 13, 1960.
Annual Spring Meeting: Roosevelt Hotel, New Orleans, La., February 11-14, 1961.

AMERICAN SOCIETY OF OPHTHALMOLOGIC AND OTOLARYNGOLOGIC ALLERGY.

President: Dr. Walter E. Owen, Peoria, Ill.
President-Elect: Dr. Leland H. Prewitt, Ottumwa, Ia.
Vice-President: Dr. D. A. Skinner, Newark, O.
Secretary-Treasurer: Dr. Daniel S. DeStio, 121 S. Highland Ave., Pittsburgh 6, Pa.
Annual Meeting: Palmer House, Chicago, Ill., October 8, 1960.

ASSOCIACAO MEDICA DO INSTITUTO PENIDO BURNIER—CAMPINAS.

President: Dr. Alberto Gallo.
First Secretary: Dr. Alfredo Martinelli.
Second Secretary: Dr. Guedes de Melo Neto.
Librarian-Treasurer: Dr. L. de Souza Queiroz.
Editors for the Archives of the Society: Dr. Antonio de Almeida, Dr. Gabriel Pôrto, and Dr. Roberto Franco do Amaral.

ASOCIACION DE OTORRINOLARINGOLOGIA Y BRONCOESOFAGOLOGIA DE GUATEMALA.

Presidente: Dr. Julio Quevedo, 15 Calle Oriente No. 5.
First Vice-Presidente: Dr. Héctor Cruz, 3a Avenida Sur No. 72.
Second Vice-Presidente: Dr. José Luis Escamilla, 5a Calle Poniente No. 48.
Secretario-Tesorero: Dr. Horace Polanco, 13 Calle Poniente No. 9-D.

ASOCIACION DE OTO-RINO-LARINGOLOGIA DE BARCELONA, SPAIN.

Presidente: Dr. J. Abello.
Vice-Presidente: Dr. Luis Suñe Medan.
Secretario: Dr. Jorge Perelló, 319 Provenza, Barcelona.
Vice-Secretario: Dr. A. Pinart.
Vocal: Dr. J. M. Ferrando.

BALTIMORE NOSE AND THROAT SOCIETY.

Chairman: Dr. Walter E. Loch, 1039 No. Calvert St., Baltimore, Md.
Secretary-Treasurer: Dr. Theodore A. Schwartz.

BUENOS AIRES CLUB OTOLARINGOLOGICO.

Presidente: Dr. K. Segre.
Vice-Presidente: Dr. A. P. Belou.
Secretario: Dr. S. A. Aranz.
Pro-Secretario: Dr. J. M. Tato.
Tesorero: Dr. F. Games.
Pro-Tesorero: Dr. J. A. Bello.

CANADIAN OTOLARYNGOLOGICAL SOCIETY SOCIETE CANADIENNE D'OTOLARYNGOLOGIE.

President: Dr. Gordon H. Francis, 925 W. Georgia St., Vancouver, B. C.
Secretary: Dr. Donald M. MacRae, 324 Spring Garden Road, Halifax, Nova Scotia.
Meeting:

CENTRAL ILLINOIS SOCIETY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY.

President: Dr. G. E. Hartenbower, 203 N. Main St., Bloomington, Ill.
President-Elect: Dr. Edgar T. Blair, Springfield, Ill.
Vice-President: Dr. G. LeRoy Porter, Urbana, Ill.
Delegate at Large: Dr. S. G. Baldwin, Danville, Ill.
Secretary-Treasurer: Dr. C. L. Pannabecker, Peoria, Ill.

CHICAGO LARYNGOLOGICAL AND OTOLOGICAL SOCIETY.

President: Dr. George Woodruff, Woodruff Clinic, Joliet, Ill.
Vice-President: Dr. Linden Wallner, 122 So. Michigan, Chicago, Ill.
Secretary-Treasurer: Dr. Robert Lewy, 25 East Washington St., Chicago 2, Ill.
Meeting: First Monday of each month, October through May.

CHILEAN SOCIETY OF OTOLARYNGOLOGY.

President: Dr. Enrique Grünwald S.
Vice-President: Dr. Agustin Estartus.
Secretary: Dr. Marcos Chaimovich S.
Treasurer: Dr. Benjamin Kapkan K.
Director: Dr. Alberto Basterrica A.

COLORADO OTOLARYNGOLOGY SOCIETY.

President: Dr. James T. Blair, Denver, Colo.
Vice-President: Dr. James Rigg, Grand Junction, Colo.
Secretary: Dr. Will P. Pirkey, Denver, Colo.

COLUMBUS, OHIO, OPHTHALMOLOGICAL AND OTOLARYNGOLOGICAL SOCIETY.

President: Dr. John E. Arthur.
Secretary: Dr. M. L. Battles.
Meetings: First Monday of October through May, University Club, Columbus, O.

DALLAS ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY.

President: Dr. Edward A. Newell.
Vice-President: Dr. Thomas M. McCrory.
Secretary-Treasurer: Dr. James L. Baldwin, 1627 Medical Arts Bldg., Dallas, Tex.

FEDERACION ARGENTINA, DE SOCIEDADES DE OTORRINOLARINGOLOGIA.

Secretary of the Interior: Prof. Dr. Atilio Viale del Carril.
Secretary of the Exterior: Dr. Aldo G. Remorino.
Secretary Treasury: Prof. Dr. Antonio Carrascosa.
Pro-Secretary of the Interior: Prof. Dr. Carlos P. Mercandino.
Pro-Secretary of the Exterior: Prof. Dr. James A. del Sel.
Pro-Secretary of the Treasury: Dr. Jorge Zubizarreta.

FIRST CENTRAL AMERICAN CONGRESS OF OTORHINOLARYNGOLOGY.

President: Dr. Victor M. Noubleau, San Salvador.
Secretary-Treasurer: Dr. Hector R. Silva, Calle Arce No. 84, San Salvador, El Salvador, Central America.

FLORIDA SOCIETY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY.

President: Dr. G. Dekle Taylor, Jacksonville, Fla.
President-Elect: Dr. Kenneth S. Whitmer, Miami, Fla.
First Vice-President: Dr. William H. Anderson, Jr., Ocala, Fla.
Second Vice-President: Dr. Marion W. Hester, Lakeland, Fla.
Secretary-Treasurer: Dr. Joseph W. Taylor, Jr., 1 Davis Blvd., Tampa 6, Fla.

FOURTH LATIN-AMERICAN CONGRESS OF OTORINOLARINGOLOGIA.

President: Dr. Dario.
Secretary:
Meeting:

FORT WORTH EYE, EAR, NOSE AND THROAT SOCIETY.

President: Dr. Van D. Rathgeber.
Vice-President: Dr. William Skokan.
Secretary-Treasurer: Dr. Paul Rockwell.

GREATER MIAMI EYE, EAR, NOSE AND THROAT SOCIETY.

President: Dr. Mariano C. Caballero.
Vice-President: Dr. Joseph Freeman.
Secretary-Treasurer: Dr. H. Carlton Howard.
Meeting: Quarterly in March, May, October and December on the second Thursday of the month, 6:30 P.M., at the McAllister Hotel, Miami, Fla.

INTERNATIONAL BRONCHOESOPHAGOLOGICAL SOCIETY.

President: Dr. Jo Ono, Tokyo, Japan.
Secretary: Dr. Chevalier L. Jackson, 3401 N. Broad St., Philadelphia 40, Pa., U. S. A.
Meeting:

KANSAS CITY SOCIETY OF OTOLARYNGOLOGY AND OPHTHALMOLOGY.

President: Dr. Clarence H. Steele.
President-Elect: Dr. Dick H. Underwood.
Secretary: Dr. James T. Robison, 4620 J. C. Nichols Parkway, Kansas City, Mo.
Meeting: Third Thursday of November, January, February and April.

LOS ANGELES SOCIETY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY.

President: Dr. Max E. Pohlman.
Secretary-Treasurer: Dr. Wendell C. Irvine.
Chairman of Ophthalmology Section: Dr. Carroll A. McCoy.
Secretary of Ophthalmology Section: Dr. Philip D. Shanedling.
Chairman of Otolaryngology Section: Dr. Robert W. Godwin.
Secretary of Otolaryngology Section: Dr. Francis O'N. Morris.
Place: Los Angeles County Medical Association Bldg., 1925 Wilshire Blvd., Los Angeles, Calif.
Time: 6:30 P.M. last Monday of each month from September to June, inclusive—Otolaryngology Section. 6:30, first Thursday of each month from September to June, inclusive—Ophthalmology Section.

LOUISIANA-MISSISSIPPI OPHTHALMOLOGICAL AND OTOLARYNGOLOGICAL SOCIETY.

President: Dr. Arthur V. Hays.
Secretary: Dr. Edley H. Jones, 1301 Washington St., Vicksburg, Miss.
Meeting: Edgewater Gulf Hotel, Edgewater Park, Miss., May 12-13, 1961.

MEMPHIS SOCIETY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY.

Chairman: Members serve as chairman in alphabetical order monthly.
Secretary-Treasurer: Dr. Roland H. Myers, 1720 Exchange Bldg., Memphis, Tenn.
Assistant Secretary-Treasurer: Dr. William F. Murrah, Jr., Exchange Bldg., Memphis, Tenn.
Meeting: Second Tuesday in each month at 8:00 P.M. at Memphis Eye, Nose and Throat Hospital.

MEXICAN ASSOCIATION OF PLASTIC SURGEONS.

President: Dr. Cesar LaBoide, Mexico, D. F.
Vice-President: Dr. M. Gonzales Ulloa, Mexico, D. F.
Secretary: Dr. Juan De Dios Peza, Mexico, D. F.

MEXICAN SOCIETY OF OTOLARYNGOLOGY.

President: Dr. Rafael Giorgana.
Secretary: Dr. Carlos Valenzuela, Petrarca 332-1, Mexico 5, D. F.

MISSISSIPPI VALLEY MEDICAL SOCIETY.

President: Dr. Arthur S. Bristow, Princeton, Mo.
Secretary-Treasurer: Dr. Harold Swanberg, Quincy, Ill.
Assistant Secretary-Treasurer: Dr. Jacob E. Reisch, Springfield, Ill.

NETHERLANDS SOCIETY OF OTO-RHINO-LARYNGOLOGY. (Nederlandsche Keel-Neus-Oorheelkundige Vereeniging.)

President: Dr. H. Navis, Sonsbeekweg 6, Arnhem.
Secretary: Dr. W. H. Struben, J. J. Viottastraat 1, Amsterdam.
Treasurer: Mrs. F. Velleman-Pinto, Jac. Ohrechtstr. 66, Amsterdam.

NORTH CAROLINA EYE, EAR, NOSE AND THROAT SOCIETY.

President: Dr. J. C. Peele, Kinston Clinic, Kinston, N. C.
Vice-President: Dr. George E. Bradord, Winston-Salem, N. C.
Secretary-Treasurer: Dr. J. D. Stratton, 1012 Kings Drive, Charlotte 7, N. C.
Meeting:

NORTH OF ENGLAND OTOLARYNGOLOGICAL SOCIETY.

President: Mr. G. L. Thompson, 16 Ramshill Road, Scarborough, Yorkshire.
Vice-President: Mr. J. H. Otty, Frizley Old Hall, Frizinghall Road, Bradford, Yorkshire.
Secretary and Treasurer: Mr. R. Thomas, 27 High Petergate, York, Yorkshire.

OREGON ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY.

President: Dr. David D. DeWeese, 1216 S. W. Yamhill St., Portland 5, Ore.
Secretary-Treasurer: Dr. Paul B. Myers, 223 Medical Dental Bldg., Portland 5, Ore.
Meeting: Fourth Tuesday of each month from September through May, Henry Thiele Restaurant, 23rd and W. Burnside, Portland, Ore.

OTOSCLEROSIS STUDY GROUP.

President: Dr. E. H. Campbell, 133 So. 36th St., Philadelphia 4, Pa.
Secretary-Treasurer: Dr. Raymond Jordan, 121 University Place, Pittsburgh, Pa.
Meeting: Palmer House, Chicago, Ill., October, 1960.

PACIFIC COAST OTO-OPHTHALMOLOGICAL SOCIETY.

President: Dr. John F. Tolan, 1118-9th Ave., Seattle 5, Wash.
Secretary-Treasurer: Dr. Homer E. Smith, 686 Twelfth Ave., Salt Lake City, Utah.
Meeting:

PAN AMERICAN ASSOCIATION OF OTO-RHINO-LARYNGOLOGY AND BRONCHO-ESOPHAGOLOGY.

President: Dr. Paul Holinger, 700 No. Michigan Blvd., Chicago, Ill.
Executive Secretary: Dr. Chevalier L. Jackson, 3401 No. Broad St., Philadelphia 40, Pa., U. S. A.
Meeting: Seventh Pan American Congress of Oto-Rhino-Laryngology and Broncho-Esophagology.
Time and Place:

PHILADELPHIA LARYNGOLOGICAL SOCIETY.

President: Dr. John J. O'Keefe.
Vice-President: Dr. Joseph P. Atkins.
Secretary: Dr. William A. Lell.
Executive Committee: Dr. Harry P. Schenck, Dr. Benjamin H. Shuster, Dr. William A. Lell, Dr. William J. Hitschler, and Dr. Chevalier L. Jackson.

PHILIPPINE SOCIETY OF OTOLARYNGOLOGY AND BRONCHO-ESOPHAGOLOGY.

President: Dr. Cesar F. Villafuerte.
Vice-President: Dr. Napoleon C. Ejercito.
Secretary-Treasurer: Dr. Eusebio E. Llamas.
Directors: Dr. Antonio L. Roxas and Dr. Armando T. Chiong.

PITTSBURGH OTOLOGICAL SOCIETY.

President: Dr. Emory A. Rittenhouse, 203 Masonic Bldg., McKeesport, Pa.
Vice-President: Dr. Carson S. Demling, 513 Jenkins Bldg., Pittsburgh 22, Pa.
Secretary-Treasurer: Dr. Clyde B. Lamp, 8101 Jenkins Arcade, Pittsburgh 22, Pa.

PORTUGUESE OTORHINOLARYNGOLOGICAL SOCIETY.

President: Dr. Albert Luis de Mendonca.
Secretary: Dr. Antonio da Costa Quinta, Avenida, de Liberdale 65, 1° Lisbon.

PUGET SOUND ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY.

President: Dr. Clifton E. Benson, Bremerton, Wash.
President-Elect: Dr. Carl D. F. Jensen, Seattle, Wash.
Secretary: Dr. Willard F. Goff, 1215 Fourth Ave., Seattle, Wash.

SIXTH INTERNATIONAL CONGRESS ON DISEASES OF THE CHEST.

Meeting: University of Vienna, August 29 to September 1, 1960.

RESEARCH STUDY CLUB OF LOS ANGELES, INC.

Chairman: Dr. Orrie E. Ghrist, 210 N. Central Ave., Glendale, Calif.
Treasurer: Dr. Norman Jesberg, 500 So. Lucas Ave., Los Angeles 17, Calif.
Otolaryngology: Dr. Russell M. Decker, 65 N. Madison Ave., Pasadena 1, Calif.
Ophthalmology: Dr. Warren A. Wilson, 1930 Wilshire Blvd., Los Angeles 57, Calif.
Mid-Winter Clinical Convention annually, the last two weeks in January at Los Angeles, Calif.

SECTION ON OTOLARYNGOLOGY OF THE MEDICAL SOCIETY OF THE DISTRICT OF COLUMBIA.

Chairman: Dr. Morris E. Krucoff.
Vice-Chairman: Dr. Max J. Fischer.
Secretary: Dr. Adrian J. Delaney.
Treasurer: Dr. Robert D. Ralph.
Meetings are held the second Tuesday of September, November, January, March and May, at 6:30 P.M.
Place: Army and Navy Club, Washington, D. C.

SCOTTISH OTOLARYNGOLOGICAL SOCIETY.

President: Dr. F. T. Land, 13 Newton Place, Glasgow, C. 3.
Secretary-Treasurer: Dr. J. F. Birrell, 14 Moray Place, Edinburgh.
Assistant Secretary: Dr. H. D. Brown Kelly, 11 Sandyford Place, Glasgow, C. 3.

SOCIEDAD COLUMBIANA DE OFTALMOLOGIA Y OTORRINOLARINGOLOGIA (BOGOTA, COLUMBIA).

Presidente: Dr. Alfonso Tribin P.
Secretario: Dr. Felix E. Lozano.
Tesorero: Dr. Mario Arenas A.

SOCIEDAD CUBANA DE OTO-LARINGOLOGIA.

President: Dr. Reinaldo de Villiers.
Vice-President: Dr. Jorge de Cárdenas.
Secretary: Dr. Pablo Hernandez.

SOCIEDAD DE ESTUDIOS CLINICOS DE LA HABANA.

Presidente: Dr. Frank Canosa Lorenzo.
Vice-Presidente: Dr. Julio Sanguily.
Secretario: Dr. Juan Portuondo de Castro.
Tesorero: Dr. Luis Ortega Verdes.

SOCIEDAD DE OTORRINOLARINGOLOGIA Y BRONCOESOFAGOSCOPIA DE CORDOBA.

Presidente: Dr. Aldo Remorino.
Vice-Presidente: Dr. Luis E. Olsen.
Secretario: Dr. Eugenio Romero Diaz.
Tesorero: Dr. Juan Manuel Pradales.
Vocales: Dr. Osvaldo Suárez, Dr. Nondier Asis R., Dr. Jorge Bergallo Yofre.

SOCIEDAD DE OTO-RINO-LARINGOLOGIA, COLEGIO MEDIO DE EL SALVADOR, SAN SALVADOR, C. A.

President: Dr. Salvador Mixco Pinto.
Secretary: Dr. Daniel Alfredo Alfaro.
Treasurer: Dr. Antonio Pineda M.

SOCIEDAD ESPANOLA DE OTORRINOLARINGOLOGIA.

Presidente: Dr. D. Adolfo Hinojar Pons.
Vice-Presidente: Dr. D. Jose Perez Mateos.
Secretario General: Dr. D. Francisco Marañés.
Tesorero: Dr. D. Ernesto Alonso Ferrer.

SOCIEDAD MEXICANA DE OTORRINOLARINGOLOGIA

Monterrey 47-201
Mexico 7, D. F.

President: Dr. Rafael Giorgana.
Secretary: Dr. Carlos Valenzuela.
Treasurer: Dr. Benito Madariaga.
First Vocal: Dr. Rafael González.
Second Vocal: Dr. Juan Oberhauser.

SOCIEDAD NACIONAL DE CIRUGIA OF CUBA.

Presidente: Dr. Reinaldo de Villers.
Vice-Presidente: Dr. César Cabrera Calderin.
Secretario: Dr. José Xirau.
Tesorero: Dr. Alfredo M. Petit.
Vocal: Dr. José Gross.
Vocal: Dr. Pedro Hernández Gonzalo.

SOCIEDAD OTO-RINO-LARINGOLOGIA DE LOS HOSPITALES DE MADRID.

Presidente: Dr. Don Fernando Beltrán Castillo.
Secretario General: Dr. Don Alfonso Vassallo de Mumbert.
Tesorero: Dr. Don Rafael Garcia Tapia.

SOCIEDAD DE OTORRINOLARINGOLOGIA Y BRONCOESOFAGOLOGIA DEL NORESTE.

Presidente: Dr. Livio M. Lataza C.
Secretario: Dr. Ramón Prieto.
Tesorero: Dr. José Gomez Galizia.
Vocales: Dres. Enrique del Buono y O. Benjamin Serrano.

SOCIEDAD VENEZOLANA DE OTORRINOLARINGOLOGIA.

Presidente: Dr. Gabriel Briceño Romero.
Vice-Presidente: Dr. Silvestre Rincón Fuenmayor.
Secretario General: Dr. Oscar Bustamante Miranda.
Tesorero: Dr. Arturo Marrero Gómez.
Vocales: Dr. Miguel Octavio Russa, Dr. Benjamin Briceño, Dr. Oscar Gonzalez Castillo.

SOCIEDADE DE OFTALMOLOGIA E OTORRINOLARINGOLOGIA DO RIO GRANDE DO SUL.

President: Dr. Ivo Adolpho Kuhl.
Secretary: Dr. Decio Lisboa Castro.
Treasurer: Dr. Jorge Valentin.

SOCIEDAD PANAMENA DE OTORRINOLARINGOLOGIA.

Presidente: Dr. Manuel Preciado.
First Vice-Presidente: Dr. Alonso Roy.
Second Vice-Presidente: Dr. Carlos Arango Carbone.
Secretario: Dr. María Esther Villalaz.
Tesorero: Dr. Ramòn Crespo.

SOCIEDADE PORTUGUESA DE OTORRINOLARINGOLOGIA E DE BRONCO-ESOFAGOLOGIA.

Presidente: Dr. Alberto Luis De Mendonca.
Vice-Presidente: Dr. Jaime de Magalhaes.
1.° Secretario: Dr. Antonio da Costa Quinta.
2.° Secretario: Dr. Albano Coelho.
Tesoureiro: Dr. Jose Antonio de Campos Henriques.
Vogais: Dr. Teofilo Esquivel.
Dr. Antonio Cancela de Amorim.
Sede: Avenida da Liberdade, 65, 1°, Lisboa.

SOCIETY OF MILITARY OTOLARYNGOLOGISTS.

President: Capt. Maurice Schiff, MC, USN, U. S. Naval Hospital, Oakland, Calif.
Secretary-Treasurer: Lt. Col. James E. Lett, USAF, MC, 209 Tamworth, San Antonio 13, Tex.
Meeting: Concurrent with the Academy of Ophthalmology and Otolaryngology, Chicago, Ill., October, 1960.

SOUTH CAROLINA SOCIETY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY.

President: Dr. L. D. Lide, Florence, S. C.
President-Elect: Dr. Harry Ross, Anderson, S. C.
Vice-President: Dr. David Stack, Spartanburg, S. C.
Secretary-Treasurer: Dr. Roderick Macdonald, Rock Hill, S. C.
Meeting: Jointly with the North Carolina Eye, Ear, Nose and Throat Society in Greenboro, N. C. Headquarters will be in the King Cotton Hotel, Sept. 13-15, 1960.

SOUTH WESTERN LARYNGOLOGICAL ASSOCIATION.
(United Kingdom)

President: Mr. Michael Robert Sheridan, F.R.C.S., 7 Strangways Terrace, Truro, Cornwall.
Secretary and Treasurer: Mr. James Freeman, F.R.C.S., 22 Downs Park West, Bristol, 6.

SOUTHERN MEDICAL ASSOCIATION, SECTION ON OPHTHALMOLOGY AND OTOLARYNGOLOGY.

Chairman: Dr. George M. Haik, Professor and Head of the Department of Ophthalmology at Louisiana State University School of Medicine, 812 Maison Blanche Building, New Orleans 16, La.
Chairman-Elect: Dr. Mercer G. Lynch, Assistant Professor of Otolaryngology, Tulane University School of Medicine, 3503 Prytania St., New Orleans 15, La.
Vice-Chairman: Dr. Bernard J. McMahon, Director of the Department and Clinical Professor of Otolaryngology, St. Louis University School of Medicine, 8230 Forsythe Blvd., Clayton 24, Mo.
Secretary: Dr. Albert C. Esposito, First Huntington National Bank Building, Huntington, W. Va. Formerly instructor of Ophthalmology, Ohio State University College of Medicine, Columbus, O.
Meeting: St. Louis, Mo., October 31, 1960, to November 3, 1960.

VIRGINIA SOCIETY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY.

President: Dr. Benjamin Sheppard, 301 Medical Arts Building, Richmond, Va.
President-Elect: Dr. Emanuel U. Wallerstein, Professional Building, Richmond, Va.
Vice-President: Dr. Calvin T. Burton, Medical Arts Building, Roanoke, Va.
Secretary-Treasurer: Dr. Maynard P. Smith, 600 Professional Building, Richmond, Va.

WEST VIRGINIA ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY.

President: Dr. Nime K. Joseph, Wheeling, W. Va.
President-Elect: Dr. John A. B. Holt, Charleston, W. Va.
Vice-President: Dr. William K. Marple, Huntington, W. Va.
Secretary-Treasurer: Dr. Albert C. Esposito, Huntington, W. Va.
Director for Two Years: Dr. James T. Spencer, Charleston, W. Va.

VOLUME LXX JUNE, 1960 NUMBER 6

THE LARYNGOSCOPE

FOUNDED IN 1890
BY
MAX A. GOLDSTEIN, M.D.

PUBLISHED BY
THE LARYNGOSCOPE
640 SOUTH KINGSHIGHWAY ST. LOUIS (10), MO., U.S.A.

VOLUME LXX JUNE, 1960 NUMBER 6

CONTENTS

DYSRHYTHMIA IN THE POST-CALORIC NYSTAGMUS. ITS CLINICAL SIGNIFICANCE. J. S. Riesco-MacClure, M.D., (By Invitation), and Malcolm H. Stroud, M.D., (By Invitation), St. Louis, Mo. 697

PSEUDO-OTOSCLEROSIS. Victor Goodhill, M.D., Los Angeles, Calif. 722

A COMPARATIVE IN VITRO EVALUATION OF VARIOUS ANTIBIOTICS. David A. Dolowitz, M.D., Lowell A. Woodbury, Ph.D., (By Invitation), and Ralph Knight, Ph.D., (By Invitation), Salt Lake City, Utah - 758

PITFALLS IN THE DIAGNOSIS OF CANCER OF THE LARYNX. Walter H. Maloney, M.D., Cleveland, O. - - - - - - - - - - - - - 774

LARYNGOGRAMS: THEIR VALUE IN THE DIAGNOSIS AND TREATMENT OF LARYNGEAL LESIONS. A STUDY BASED ON CLINICAL, RADIOGRAPHIC AND PATHOLOGIC FINDINGS ON 99 PATIENTS WITH CANCER OF THE LARYNX. Joseph H. Ogura, M.D., William E. Powers, M.D., (By Invitation), Sumner Holtz, M.D., (By Invitation), Malcolm H. McGavran, M.D., (By Invitation), Bruce Ellis, M.D., (By Invitation), and Richard Voorhees, M.D., (By Invitation), St. Louis, Mo. - - - - - - - - - - - - - - - 780

THE APPLICATION OF IN VITRO CYTOTOXIC REACTIONS TO CLINICAL DIAGNOSIS OF FOOD ALLERGY. Wm. T. K. Bryan, M.D., and Marian P. Bryan, B.A., St. Louis, Mo. - - - - - - - - - - 810

PSEUDO NEURAL HYPACUSIS IN CHILDREN. Seymour J. Brockman, M.D., and Gloria H. Hoversten, M.A., (By Invitation), Los Angeles, Calif. - 825

BILATERAL TONSILLECTOMY FOR PERITONSILLAR ABSCESS. Benjamin M. Volk, M.D., and Edward C. Brandow, Jr., M.D., (By Invitation), Albany, N. Y. - - - - - - - - - - - - - - - - - 840

LYMPHOSARCOMA OF TONSIL. DISCUSSION AND REPORT OF CASE WITH RECOVERY. Fordyce Johnson, M.D., Pasadena, Calif. - - - - - 846

PSYCHOGENIC PROBLEMS. C. Stewart Nash, M.D., Rochester, N. Y. 853

DIRECTORY OF OTOLARYNGOLOGIC SOCIETIES - - - - - - - - - - 860

THE LARYNGOSCOPE

A MONTHLY JOURNAL ON DISEASES OF THE

EAR - NOSE - THROAT

FOUNDED IN 1896

BY

DR. MAX A. GOLDSTEIN

OFFICIAL ORGAN

OF THE

AMERICAN LARYNGOLOGICAL, RHINOLOGICAL AND OTOLOGICAL SOCIETY, INC.

Subscription Price in United States, $15.00 per year; Canada, $15 50; all other foreign countries, $16.00 in advance.

Published By THE LARYNGOSCOPE

640 South Kingshighway St. Louis 10, Mo., U. S. A.

Entered at Post Office, St. Louis, as Second-Class Matter.

WHICH ONE IS THE BLEEDER?

CASE NO. 1
Blood Coagulation Time 3 min. 15 sec.
Bleeding Time . 1 min. 30 sec.

CASE NO. 2
Blood Coagulation Time 3 min. 25 sec.
Bleeding Time . 1 min. 20 sec.

CASE NO. 3
Blood Coagulation Time . 3 min.
Bleeding Time . 1 min. 30 sec.

CASE NO. 4
Blood Coagulation Time 3 min. 15 sec.
Bleeding Time . . . . . 2 min.

CASE NO. 5
Blood Coagulation Time 3 min. 10 sec.
Bleeding Time . 1 min. 40 sec.

All had normal blood studies—yet one had a bleeding problem.

Adrenosem®*

SALICYLATE

(Brand of carbazochrome salicylate)

*U.S. Pat. Nos. 2581850, 2586294

THE S. E. MASSENGILL COMPANY

Bristol, Tennessee • New York • Kansas City • San Francisco

Adrenosem®

SALICYLATE

(Brand of carbazochrome salicylate)

TO CONTROL THE MOST COMMON CAUSE OF BLEEDING

5

The most common cause of bleeding is increased capillary permeability, according to recent studies. Coagulative defects, the least common cause, occurred in less than one of every four patients whose chief complaint was abnormal bleeding.*

Without a history of bleeding, there is no way of determining whether a patient tends to exhibit increased capillary permeability. Therefore many surgeons administer Adrenosem preoperatively as a standard safety measure.

Adrenosem controls bleeding by decreasing excessive capillary permeability and promoting retraction of severed capillary ends. Thus it controls the chief cause of bleeding. Its high index of safety, with no contraindications at recommended dosage levels, establishes Adrenosem as a standard preventive measure, even where there is no history of abnormal bleeding.†

A VALUABLE ADJUNCT TO SURGERY

The preoperative use of Adrenosem adds an extra measure of safety during surgical procedures. It makes good technic even better, by providing a clear operative field.

*E. Cheraskin: The Control of Bleeding, J. Am. Dent. Assn., 58:17 (Apr., 1959).

†Extensive bibliography available on request.

SUPPLIED:

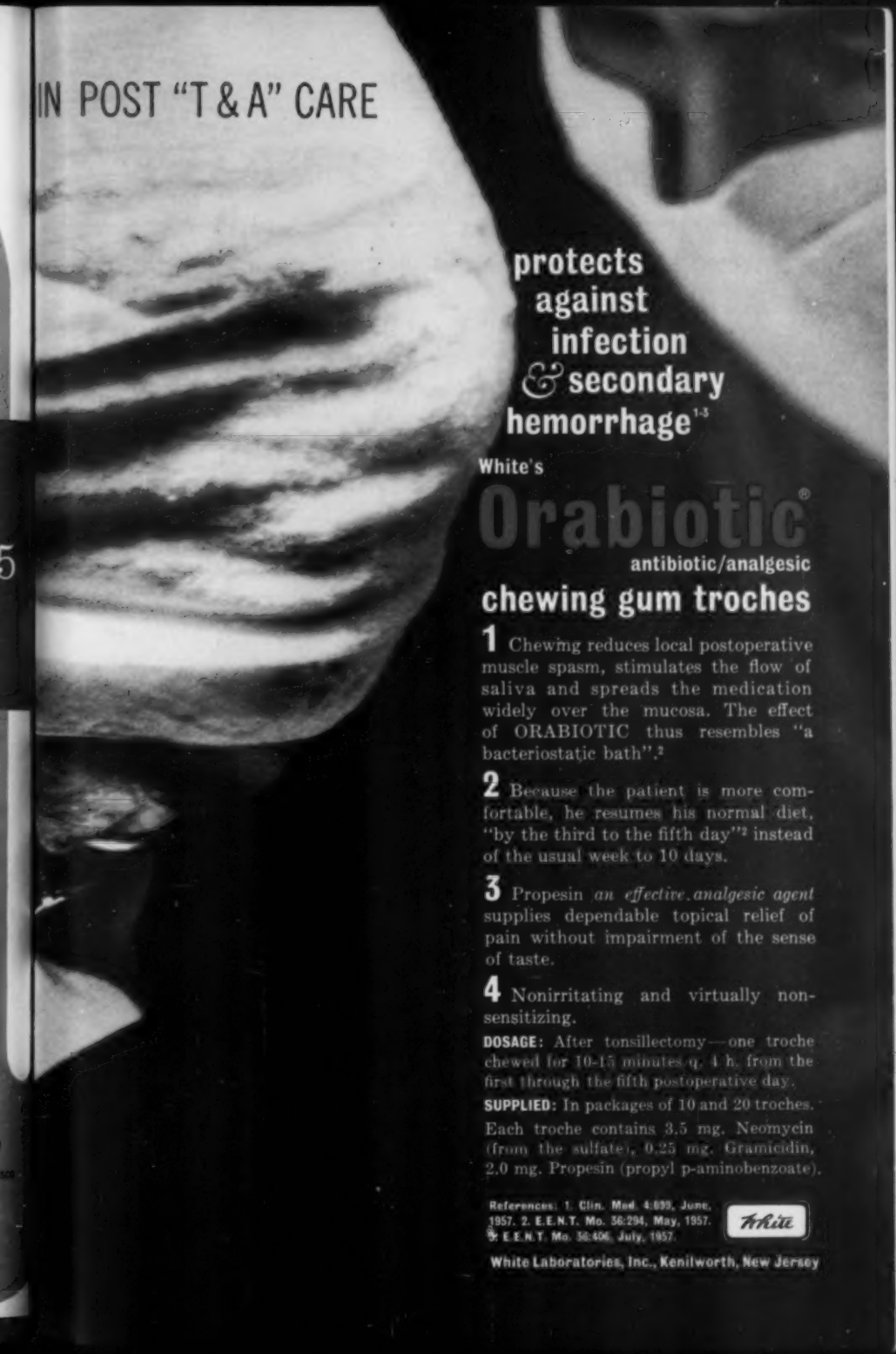
AMPULS—1 cc., 5 mg.

TABLETS—1 and 2.5 mg.

SYRUP—each 5 cc., 2.5 mg.

The S. E. Massengill Company

BRISTOL, TENNESSEE • NEW YORK • KANSAS CITY • SAN FRANCISCO



protects against infection & secondary hemorrhage[1-3]

White's

Orabiotic®

antibiotic/analgesic

chewing gum troches

1 Chewing reduces local postoperative muscle spasm, stimulates the flow of saliva and spreads the medication widely over the mucosa. The effect of ORABIOTIC thus resembles "a bacteriostatic bath".[2]

2 Because the patient is more comfortable, he resumes his normal diet, "by the third to the fifth day"[2] instead of the usual week to 10 days.

3 Propesin *an effective analgesic agent* supplies dependable topical relief of pain without impairment of the sense of taste.

4 Nonirritating and virtually nonsensitizing.

DOSAGE: After tonsillectomy—one troche chewed for 10-15 minutes q. 4 h. from the first through the fifth postoperative day.

SUPPLIED: In packages of 10 and 20 troches. Each troche contains 3.5 mg. Neomycin (from the sulfate), 0.25 mg. Gramicidin, 2.0 mg. Propesin (propyl p-aminobenzoate).

References: 1. Clin. Med. 4:699, June, 1957. 2. E.E.N.T. Mo. 36:294, May, 1957. 3. E.E.N.T. Mo. 36:406, July, 1957.

White

White Laboratories, Inc., Kenilworth, New Jersey

Sounding Board

News of Interest in the Field of Noise Control

Differing Audiograms Show Value of Controlled Test Environments

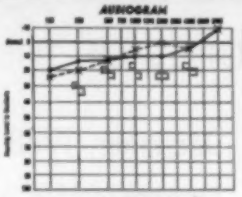
A case where the same subject produced two differing audiograms when tested at two different times and places, has focused the attention of the hearing profession on the problem of obtaining valid and accurate audiograms from patients.

This problem becomes magnified many times over where audiograms are used as a basis for middle ear surgery, medical-legal adjudication and proper *rehabilitative* procedures.

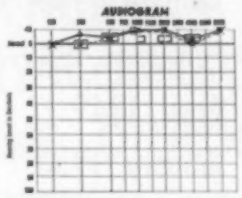
Use of Examination Rooms Indicated

One way to assure consistent and accurate audiograms is to control the testing environment by excluding extraneous noises which will interfere with a successful test. This is being accomplished with IAC Audiometric Examination Rooms which provide the proper testing environment necessary for obtaining accurate and valid audiograms with the use of a calibrated audiometer.

IAC Audiometric Examination Rooms are available in many pre-fabricated models or can be engineered for special audiometric installations in conjunction with the builder and architect. Circle 18.



Audiogram of a young female measured in an average testing environment.



Audiogram of the same female measured in an IAC Audiometric Examination Room

Patient conducts his own hearing test with a Rudmose ARJ-4 Automatic Audiometer while seated in an IAC Audiometric Examination Room.

Rudmose Automatic Audiometers Distributed by Industrial Acoustics

Audiometers which are completely automatic and which make it possible to test more patients daily are now being distributed by Industrial Acoustics Company for use with IAC Audiometric Examination Rooms. Circle 19.

New literature available:

Complete data on Hearing Conservation Programs. Circle 20.

Information on construction of complete Audiology Clinics and Research Centers. Circle 21.

Medical Department L-6

INDUSTRIAL ACOUSTICS COMPANY, INC.

341 Jackson Avenue
New York 54, N.Y.
CYpress 2-0180

Please send data on: 18 19 20 21

Name _____

Address _____

City _____ Zone____ State_____

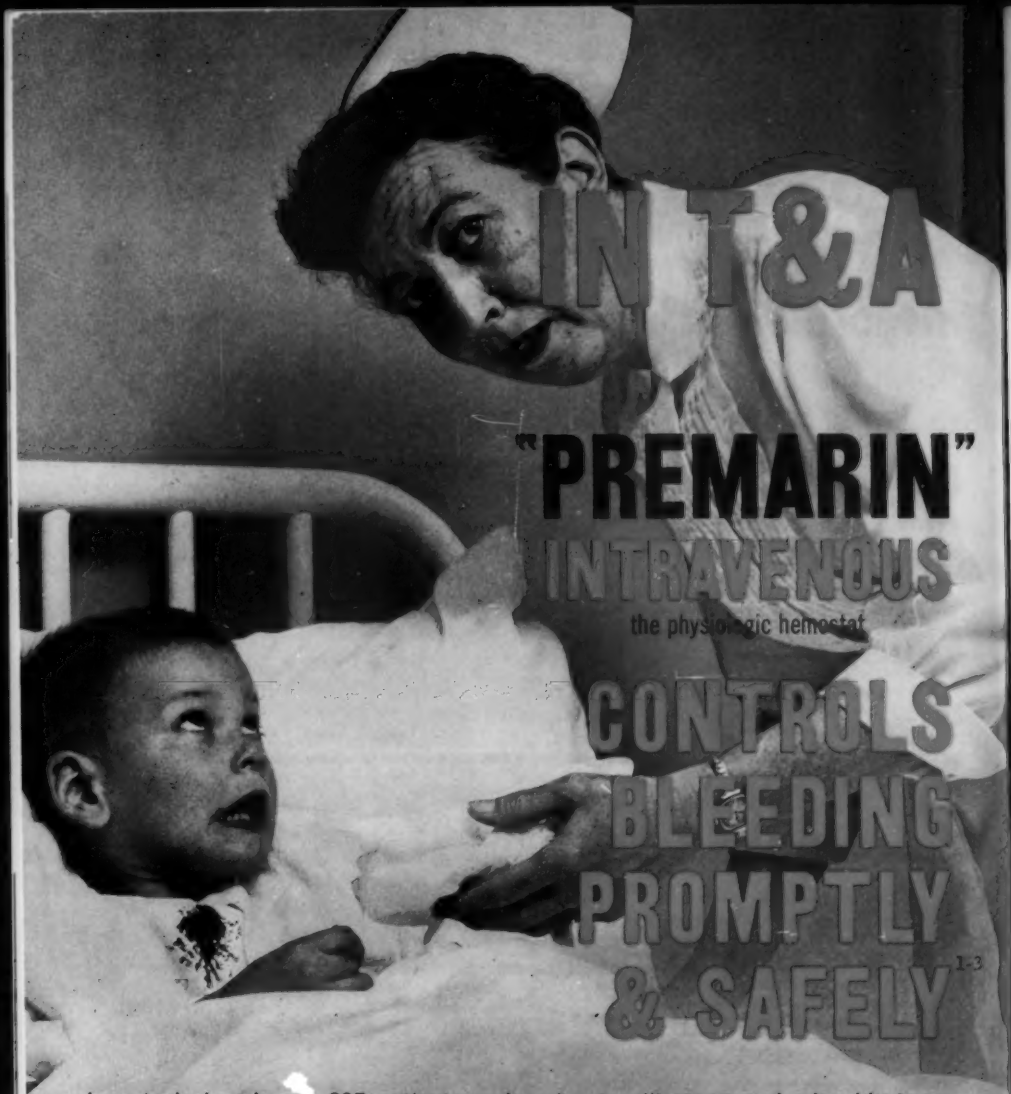
Books Received

Books and monographs received are acknowledged in this column. This notice may be regarded as a return courtesy to the publisher or author. Reviews will be published later as the editors may elect.

Notice of each book or monograph, including title, name of author, publisher, pagination, price, etc., will be presented in these notices so that our readers may have all data at their disposal for further inquiry.

La Voix Chantee. Commande Cerebral des Cordes Vocales, Classification Chronaximetrique des Tessitures Mecanismes Protecteurs du Larynx; Analyse Physiologique des Techniques Vocales et des Grandes Methodes Pedagoques. By Raoul Husson and preface by M. le Dr. Andre Moulonguet. 205 pages with Index and many illustrations. Gauthier-Villars, 55 Quaides Grands-Augustins, Paris, 1960.

The Thyroid-Vitamin Approach to Cholesterol Atheromatosis and Chronic Disease. A Ten-Year Study. By Murray Israel, M.D., Medical Director Vascular Research Foundation. Foreword by Henry L. Russek, M.D., Consultant in Cardiovascular Disease, U. S. Public Health Service Hospital, Staten Island, N. Y. 132 pages with several illustrations. The George Press, Inc., New York, N. Y., 1960.



In a typical series of 625 patients undergoing tonsillectomy and adenoidectomy, "PREMARIN" INTRAVENOUS helped to reduce the incidence of postoperative hemorrhage from an average of 5 per cent to zero.[2] "PREMARIN" INTRAVENOUS has also been used effectively to control postoperative hemorrhage, to help minimize blood loss during surgery, and to arrest epistaxis and other types of spontaneous bleeding.[3]

Over 1,000,000 injections have been given to date without a single report of toxicity.

"PREMARIN" INTRAVENOUS (conjugated estrogens, equine) is supplied in packages containing one "Secule" providing 20 mg., and one 5 cc. vial sterile diluent with 0.5% phenol U.S.P. (Dosage may be administered intramuscularly to small children.)

1. Johnson, J. F.: Paper presented at Symposium on Blood, Wayne State University, Detroit, Michigan, Jan. 18, 1957, cited in M. Science 1:33 (Mar. 25) 1957; Proc. Soc. Exper. Biol. & Med. 94:92 (Jan.) 1957. 2. Servoss, H. M., and Shapiro, F.: Digest Ophth. & Otolaryng. 20:10 (Nov.) 1957. 3. Published and unpublished case reports, Ayerst Laboratories.

AYERST LABORATORIES
New York 16, N.Y. • Montreal, Canada

NOTICE TO CONTRIBUTORS

THE LARYNGOSCOPE reserves the right of exclusive publication of all articles submitted. This does not preclude their publication in Transactions of various Societies.

Manuscripts should be typewritten, double spaced, on one side of paper only and with sufficient margins to allow for corrections.

Author's name and city should appear directly under title on first page; street address at end of article.

All prints or photographs to be submitted in black and white, in good sharp contrast. Good halftones depend upon clear photographs. Line drawings for zincs to be in black and white. Colored inks or red or blue quadrille rulings will not reproduce.

References should be complete: author's surname, initials, title of article, Journal, volume, page, month, year.

Six illustrations will be furnished for each article without cost to author. Authors will please limit illustrations to six or assume the expense of additional illustrations.

Proofs will be submitted to authors for corrections. If these are not returned, articles will be published as corrected in this office.

Reprints will be furnished at the following prices:

WITHOUT COVER

	250 Copies	500 Copies	1000 Copies	2000 Copies
Four Pages	$ 19.25	$ 23.00	$ 30.75	$ 44.50
Eight Pages	33.50	42.75	58.50	83.00
Twelve Pages	47.00	60.75	86.25	131.50
Sixteen Pages	61.00	78.75	98.75	146.75
Twenty Pages	76.00	96.25	129.50	187.25
Twenty-four Pages	88.75	112.50	150.00	217.25
Twenty-eight Pages	97.50	123.25	162.25	233.50
Thirty-two Pages	115.00	139.75	180.00	267.00

WITH COVER

Four Pages	$ 37.25	$ 46.50	$ 61.50	$ 88.75
Eight Pages	51.50	66.25	89.25	127.25
Twelve Pages	65.00	84.25	117.00	175.75
Sixteen Pages	79.00	102.25	129.50	191.00
Twenty Pages	94.00	119.75	160.25	231.50
Twenty-four Pages	106.75	136.00	180.75	261.50
Twenty-eight Pages	115.50	146.75	193.00	277.75
Thirty-two Pages	133.00	163.75	210.75	311.25

Express charges will be paid by consignee.

INDEX OF ADVERTISERS

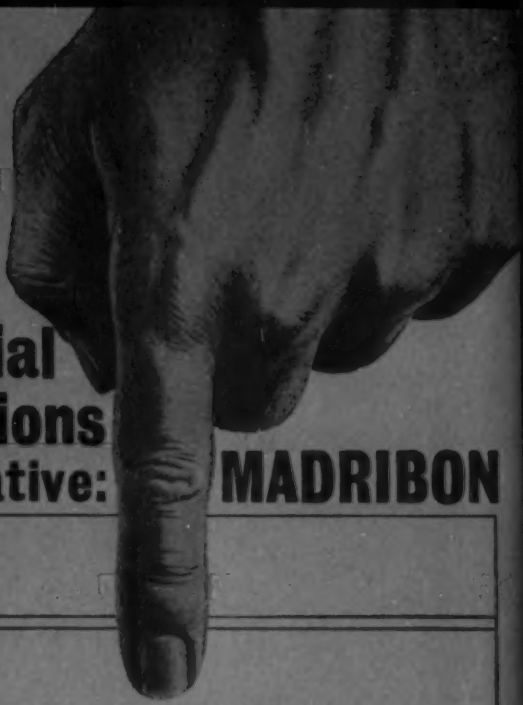
	Page
American Academy of Ophthalomology and Otolaryngology Registry	17
American Laryngological, Rhinological and Otological Society, Inc.	15
Ayerst Laboratories	20
Books Received	17
Books Wanted	14
Burroughs Wellcome & Co., Inc.	19
Central Institute for the Deaf	23
Doho Chemical Corp.	8
Eaton Laboratories	12-22
Industrial Acoustics Company, Inc.	13
Lederle Laboratories	6
S. E. Massengill Company	3-4
V. Mueller & Co.	10
Nichols Nasal Syphon, Inc.	18
Notice to Subscribers	Inside Back Cover
Otarion Listener Corp.	9
G. P. Pilling & Son Co.	7
Radium Chemical Co., Inc.	16
Roche Laboratories	Back Cover
Storz Instrument Co.	21
Surgical Mechanical Research	17
White Laboratories, Inc.	2-5-11

Notice to Subscribers

All claims for missing journals must be made within two months of date of journal not received, otherwise we cannot guarantee complete files.

THE LARYNGOSCOPE

In bacterial infections the new alternative: MADRIBON



Rx

Madribon 0.5gm

#16

Sig – Tab ii stat

then tab i

once a day –

9893

The **low cost** antibacterial prescription with assured **safety** and **effectiveness**

• wide-spectrum activity • high rate of clinical effectiveness—up to 90 per cent • exceptionally low incidence of side effects—less than 2 per cent—even in long-term use • minimal risk of hazardous superinfections • essentially no danger of anaphylactic reactions • fewer problems with the development of resistant mutants • economical therapy • *reserves antibiotic effectiveness for fulminating, life-threatening infections*

For complete information on dosage forms, dosage schedules and precautions, consult literature available on request.

MADRIBON®—2,4-dimethoxy-6-sulfanilamido-1,3-diazine ROCHE®

ROCHE LABORATORIES
Division of
Hoffmann-La Roche Inc.
Nutley 10, N. J.